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Practical Application of Industrial and Agricultural Machinery for Peat Bogs

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In taking up this subject, "Practical Application of Industrial and Agricultural Machinery for Peat Bogs," I will confine myself to the discussion of a few important features:

"Industrial Machinery," in which this society is most interested, should be classified under two heads—First, machinery for the manufacture of peat fuel and fertilizer filler, peat humus, etc.; and, second, agricultural machinery, including drainage and ditching machines, tractors, and kindred machinery designed for the preparation of humus and peat soils for cropping. All of this machinery ought to be power driven and self-propelling over the bog.

It is needless to point out here the advantage of machine work over hand labor or horse power wherever possible. In the first place, most bogs are in remote places and do not have the best facilities for taking care of the men. Hence help is hard to procure and harder to hold.

Again nearly all men are more or less interested in machinery, and no matter how simple and infantile the interest may appear to the initiated; even the laborer with pardonable pride prefers to say "I am on the ditching-machine gang," than to say, "I am on the ditching gang." Let me tell you this little story illustrative of my point: A gang of men were engaged upon an excavation job, for which the usual equipment of pick and shovel

*Read before the Eighth Annual Meeting at Duluth, Minn., Aug. 20, 1914.

and wheelbarrow was required. A newcomer on the job was naturally crowded into the pick gang, not at all to his liking. Being a progressive sort of a fellow, he took the first opportunity to get hold of a wheelbarrow and start to wheel the dirt away. One big Irishman who had been on the job from the start walked up to the newcomer, grabbed the wheelbarrow, and said: "Get back to your pick and leave that wheelbarrow alone. What the devil do you know about machinery?"

A thing of equal importance to the labor question is the mechanical problem of getting over a bog so soft that even a horse with muck shoes can scarcely get over it and still accomplish any actual work. To overcome this we must turn to the apron wheel, sometimes called the caterpillar or web wheel, and not infrequently called the flat wheel (see fig. 1). However, please do not confound this latter term with the usual railroad use, as we are sometimes inclined to believe that a street car specialty is flat wheels.

That the apron wheel is a success is an established fact, and for a given purpose it is merely a question of getting sufficient bearing surface as the details of the design of this type of wheel are now most satisfactorily worked out. I have seen 50-ton machines work over bogs that a horse could not travel over, and often with the surface covered with water to a depth of several inches.

The amount of weight that can be sustained per square foot depends to a very great extent on the fiber structure of the peat.

Another point is the proper distribution of the bearing surface. For example, a platform 2 feet square will not sustain as much weight as four platforms 1 foot square properly distributed, although both total 4 square feet. Depending as we do upon the fiber structure of the peat to assist in sustaining our weight, the greater the number of lineal feet of outline of our apron wheels the more advantage we get from this factor. For instance, the platform first mentioned as being 2 feet square would have an outline of 8 lineal feet, whereas four platforms, each 1 foot square, would have an outline of 16 lineal feet. It is, therefore, more advantageous to use two smaller aprons than one large one.

If you can get the aprons spread out and not too low, so that they will climb easily, you can get over almost any bog with

a bearing surface sufficient to sustain in the neighborhood of 325 pounds per square foot, and many machines are constructed to bear weights that run as high as 500 pounds per square foot. Apron wheels have failed more from poor design and construction than from actual inability to sustain weight.

An apron wheel made of standard roller chains, fitted with light attachment ears to receive the planking, and with chain sprockets of rather small diameter and pitch, will surely be a failure. Chains of that type were never designed for such service. They are intended as conveyor chains and for work of that nature, and for that purpose are perfectly satisfactory, but they never were designed for the strenuous service that they will be called upon to perform in an apron wheel. I personally know of several firms that have spent years of time, and thousands of dollars to develop successful apron traction, and we, as a society, would do well to profit by their experience and select their products rather than to try out "new-fangled" ideas—not that these ideas are not sometimes good, but the quality of the work and its adaptability is dependent to such an extent on the equipment to produce these parts correctly and at a price within reasonable bounds, that it is a sheer waste of money and effort for those interested in peat products to go over this same experimental ground the second time. It is the manufacturer's problem, and he has thrashed it out. He will adapt his machine to our wants, if we will but give him the opportunity. Why experiment further?

Apron wheels, although they have been highly developed within the past two years—I might even say within the past few months—are not at all a new thing. Patents were taken out early in 1840, setting forth practically the same general ideas as used today. Most of the latter patents merely covered improvements.

The most common type of apron wheel is the one made of one or two chains, with rollers at each link. The planks being secured to the under side of the links. The rollers carry the weight of the machine over a suitable elliptical frame, with drive sprocket at one end engaging the rollers, and propelling the machine ahead, the frame and sprockets forming an endless track for the chain. This type, although in common use, has some bad

features. The whole weight of the machine is carried on the chains and chain pins. The rollers are necessarily small in diameter, and must run close to the ground, so that they come in contact with dirt and water, and proper lubrication is impossible. As the rollers are small, they must rotate rapidly, and as they have the weight of the machine to carry, in addition to the work of propelling the machine, rollers and pins are rather short-lived.

A better type of machine is the one that has a frame with sprockets at each end over which the track chains run, with the planks fastened to the chain links, these track chains, in turn, forming a bearing surface for the large roller, which is usually 10 to 12 inches in diameter, and has flanges on each side, each roller being secured to the frame that carries the sprockets. The rollers, being large in diameter, do not have to turn so often, and being further away from the ground, are not so much subjected to dirt and grit. Furthermore, it requires only about one roller per lineal foot of bearing surface as against a roller at each link in the type previously mentioned.

There is still another type of wheel recently brought out by a large concern specializing on machinery of this nature, which has some decided advantages over the last type mentioned. In this newer design, the chains carrying the planks do not carry any of the weight of the machine, their work being merely to propel the machine ahead. The weight of the machine is carried by large rollers secured to the frame in ample bearings and running in a channel track bolted directly to the inner side of the plank, thus relieving the propelling chains of any of the weight of the machine. The rollers in this case do not have to be flanged, as they are guided by the channel section of track. These channel-track sections are as long as the pitch of the chain—in this case, 12 inches. The drive sprockets have 8 teeth, giving a pitch diameter of 31⅜ inches, making the overall height of the wheel about 39 inches. The length and width can be made to suit the requirements, and machines are regularly manufactured in sizes from 22 inches wide by 4 feet in length, to 8 feet wide and 16 feet in length. These two sizes, and several intermediate ones, are to-day in successful use.

Now, as to the industrial machinery for peat fuel, or fer-

tilizer filler, the most essential thing is an excavator, self-propelled on apron wheels. For peat fuel, we need some means of grinding or macerating the peat and conveying it to the drying grounds, there to be spread out and pressed or formed into blocks. This latter subject has been discussed from time to time and most of us are familiar with it. There are different ways of making peat fuel, and we have several successful peat-fuel plants in operation.

For the fertilizer-filler plant, the process is somewhat different. Although some producers harrow up the peat and dry and gather it with horses, it is generally accepted that the best method is to use the excavator, all the material being taken out as you go. With the scraping method, working from the top, a basin is formed that is flooded with each rain, at the same time destroying the bearing surface of the ground and making it impossible to continue this method to any great depth.

As we need an excavator in either case, one of exactly the same design would be available for either peat fuel, or for fertilizer production, the main difference being that in the case of peat fuel the excavator should be provided with a macerator or grinder, whereas in the filler plant it should be provided with a distributor for spreading the peat over the drying ground. After it is sun dried sufficiently it should then be gathered up and taken to the plant for a further drying process.

There are many different kinds of excavators for this purpose, and most of us are familiar with them in a general way. The ideal machine is an excavator that will automatically dig and deliver the peat, propelling itself, and taking all the peat to its maximum depth, working along a sloping bank.

There has been just such an excavator brought out within the past year and several are now in successful operation. This excavator (see fig. 1) has an endless chain and bucket and is so arranged that it digs from the side along a sloping bank at an angle of about 45 degrees, taking a slice of about 1 foot at a time, thus giving the peat a chance to drain and dry, as the sloping bank is really a drying field set at an angle of 45 degrees. An advantageous feature is that the machine does not have to run idle on a return trip nor waste time in turning around, but continues to dig forward and backward until the field is completed.

Another successful machine that has been brought out for this work is a new power scraper for gathering the dried peat from the field; also a loading machine that loads the dried peat into dump cars. With such an equipment hand labor is practically eliminated.

This new scraper, like the excavator, is a continuous worker. It is made in the form of an apron tractor. At both the front and rear are attached broad scrapers set at an angle. These are in turn lowered to the ground and the partly dried peat is pushed along up the field at an angle until it reaches the loading point. As in the excavator, no time is lost in turning around. As the end of the field is reached the scraper at the rear is raised and the one at the front is lowered, when the machine is ready to start on its return trip.

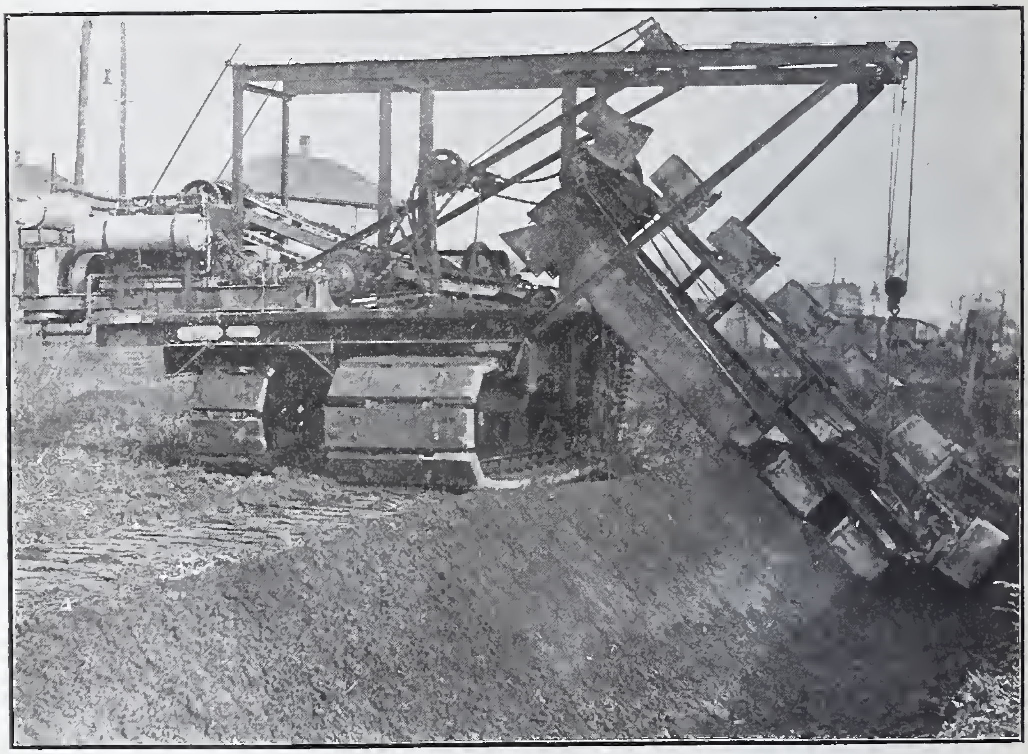

Figure 1. Peat excavator with apron wheels, cutting 4 feet deep.

Now, let us take up the subject of the cultivation of the peat land. The ordinary agricultural machinery has absolutely no place here. Machinery for this purpose must be of special de-

sign, and here the apron, or caterpillar wheels, step into the breach. The tractor stands out most prominent, and for bog work the apron wheel machine is the only successful type. First, it has such a large bearing surface, which is absolutely necessary; second, its tractive power is many times that of the round-wheel machine. Its driving wheels will not slip, and even if they should, they do not bury themselves like a round wheel, and the center of gravity is lower in an apron-wheel machine.

There are several good apron-wheel tractors on the market at present, the most prominent being the Holt caterpillar, manufactured by The Holt Caterpillar Co., at Peoria, Ill., and at Stockton, Cal., and the Bee Tee Dee tractor, manufactured by The Buckeye Traction Ditcher Co., of Findlay, Ohio.

The Holt tractor is built in several sizes, ranging from 30 to 75 horsepower. The apron wheels on this machine are driven independently by a large friction wheel, no differential being

Figure 2. Forty-horsepower tractor and pulverizer with apron wheels.

used, and with a single steering wheel ahead. These machines are built strong and durable, and the large number in use speaks best of their quality and efficiency.

The Bee Tee Dee machine (see fig. 2) was developed especially to fill the demand for a machine to be used in the reclamation of swamp land in Louisiana and Florida. The builders have manufactured practically all of the successful machines for the

ditching and draining of these marshes, and have gone further than any other manufacturers in the development of the apron-wheel type of machine. It is only natural, therefore, that a demand should be made upon them for a machine to cultivate this marsh land.

An exclusive feature of their machine is the pulverizing attachment. With this attachment, a three-fold duty is performed at one operation, namely, plowing, harrowing, and the ridding of the soil of roots. This pulverizer is hinged at the rear of the tractor and is driven from the tractor shafts by roller chains. The pulverizer proper is a large hollow shaft about 5 inches in diameter, to which are secured picks, or points, about 20 inches long, by means of steel castings clamped to the shaft. These points are placed about 2½ inches apart and form a revolving cylinder over 40 inches in diameter.

As the tractor moves slowly forward, the pulverizer points are lowered into the soil to the proper depth. The revolving picks tear up the ground, finely pulverizing the soil, and throwing the roots on the top where they may be raked up. Its greatest value is in the cultivation of new land, such as bog land, which, on account of roots, bogs, etc., cannot be plowed unless the surface is first grubbed, or in muck land where the mold-board plow cannot be used.

The standard machine is of 30 horsepower, and pulverizes to a width of 5½ feet at each trip. This machine has a capacity of three to five acres per day. The demand for a smaller pulverizer outfit for use in Florida and the Gulf States has been so insistent that a 20-horsepower outfit with a pulverizer 45 inches wide is now being brought out, and a larger machine carrying a 40-horsepower engine has also been built. We know of no other machine that would compete with this one on the work for which it is designed, and pulverizing is really the only practical method of preparing new peat soils for crops.

The proper drainage of a bog is no doubt the largest problem and involves the most money. For open ditches up to 12 feet wide and 6 inches deep with sloping banks, and for the digging of all sizes of vertical-bank ditches for tile laying and for laterals, there is a machine on the market with which we are all familiar; in fact, it is looked upon as a standard thing. I refer to the line

of machines manufactured by The Buckeye Traction Ditcher Co., of Findlay, Ohio. These ditching machines, like the tractor, are mounted on apron wheels and will go anywhere where the soil will sustain the weight of a man walking, and they often operate where the surface is covered with water even to a depth of 2 or 3 feet.

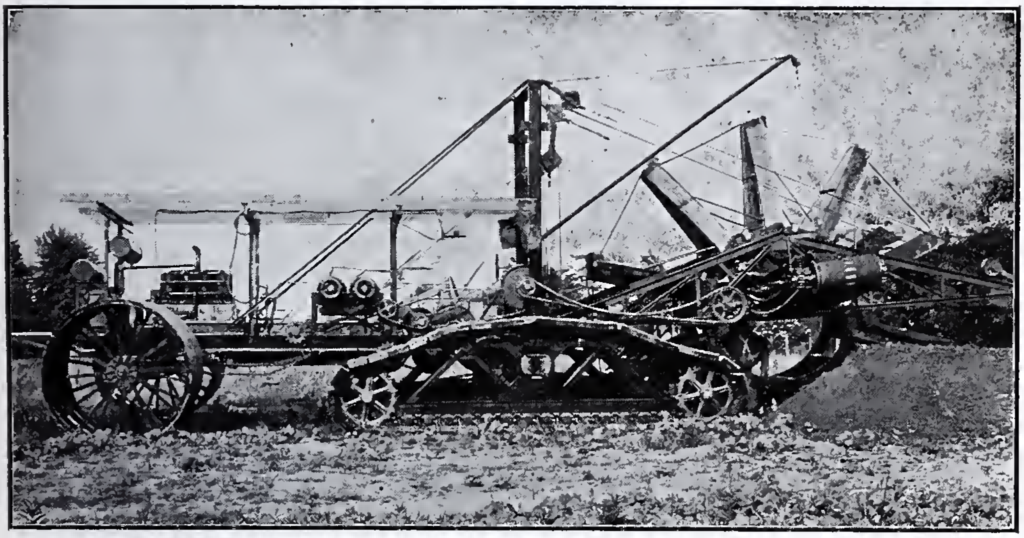

Figure 3. Excavator for open ditches, cutting ditch 5 feet wide and 6 feet deep, with sloping sides.

These open-ditch diggers (see fig. 3) have a wonderful capacity, averaging as much as one-half mile of finished ditch per day, and often digging as high as a mile and a quarter per day; and one of the features of the machine is that it digs to an absolute grade. Most of these machines are equipped with gasoline motors; all of them are equipped with power hoists and the sprockets, gears, and bearings are made of steel, in order to get great strength with the least possible weight. Three of these large open-ditch diggers have been shipped to Florida this spring and are being used for road building and general drainage work.

The tile-drainage machines (see fig. 4) range in size from 12 inches wide and 4½ feet deep up to 42 inches wide and 10 feet deep. They cut a vertical bank and their capacity is in proportion to that of the open-ditch diggers. With the small machine it is not uncommon to cut 150 to 200 rods per day. These machines, like the open-ditch diggers, cut to an absolute grade, raise and

lower the cutting wheel by power, and go from one job to another at the rate of one and a half miles per hour.

Figure 4. Machine for digging tile drainage trenches, cutting trench 14½ inches wide and 4½ feet deep.

One of the conditions encountered in shallow-muck lands is the very sticky subsoil of black or blue clay, generally known as "gumbo." Special buckets and cleaners are provided for this class of work, and in extreme cases a special wheel is used. Owing to the large capacity of this machine and the small amount of help required, it commends itself to all. At this day and age everything is done in a hurry. No one is interested in a slow proposition; here is the great advantage of power machinery, and especially is this true of ditching machines. If you wish to put a string of tile across a field and do the digging by hand, it will take you a week and sometimes a month, counting the bad

weather and necessary stoppages while working with hand labor. Think of the satisfaction of doing this same job in one day with a machine. Furthermore, you have a trench true to grade; the ground is nicely piled up and easy to back-fill; your banks are dry and clean; and your trench is absolutely straight.

There are several trench machines made that give fairly good satisfaction, and with careful selection of these machines hand work for this particular line is a thing of the past.

That the peat industry has been handicapped and imposed upon by means of fake machinery made as a result of untried ideas, we must all admit. We must stand for a reasonable amount of experimenting in any new enterprise, but we can at least steer clear of the individual who has some great evolution along some line and then who, when it comes to a deal, asks you to put up all the money to build the machine, or whatever it may be. The promoter in most cases has not enough confidence in his own scheme to invest a dollar. We all have more or less of a weakness for experimenting—everybody likes it—there is nothing so interesting, and I may add, expensive.

Apron wheels, peat diggers, and tractors, surely fall for their share of experimenting. All over the country you can find home-made tractors; you see them pictured and described in magazines with a portrait of the builder. The first argument for the building of the home-made tractors is the price one has to pay for the factory-built machine. John Smith thinks he can mount his 10-horsepower one-lunger on a truck made of a couple of mower wheels and pull a few plows. After the freak is finished, John is usually satisfied if he can pull one, and sometimes glad if it will run at all; and finally, he thanks his lucky stars that he is not out more than five hundred dollars and did the job during bad weather.

Now, we don't want to stand out against experimenting; it is good for us, it is very interesting, and if business will stand it, it is the proper thing. But one thing is certain, it is the manufacturer's problem. He has done a lot with it and is willing to do more with the help of just such men as compose this Society. The home-made machine usually costs more in the end than one from the manufacturer, and if the manufacturer's machine doesn't do the work you don't have to pay for it.

Economic Aspect of Peat in America

*By John N. Hoff, New York**

Why is one of our great national resources—peat—practically undeveloped and not taken advantage of beyond the manufacture of a little paper and pasteboard, the production of a few thousand tons of fertilizer filler, and scarcely enough peat fuel to supply the annual needs of a respectable boiler plant?

Beyond its use agriculturally for growing crops, the industry has scarcely begun. The area of peat bogs is vast and the qualities of the various deposits permit its application in at least one of various uses to which it can be put—as fuel, litter, paper stock, fertilizer filler, or directly for agricultural use. In one of these ways practically every bog drained or undrained can be utilized; yet comparatively little is being done in a commercial way. The reason for this in part is easily understood.

In our useful arts as in our daily habits of life we are prone to proceed along the lines of least resistance. Our natural resources applicable to the same uses as is peat are vast and rich.

As to Fuel. First, we must consider the immense expanse of virgin forests that greeted our forefathers, and some of which still remain. These gave an abundant and readily available supply of fuel until conditions warranted the use of our next great fuel deposits, coal, both hard and soft. Then came into use our stores of petroleum and natural gas. Better and more cheaply procured supplies of these materials will explain why peat has not been developed as a fuel. In time the dwindling supplies of wood, coal, and oil will force the practical development of peat for this purpose. Until then the peat-fuel industry is chiefly to remain experimental unless in regions favorably removed from the coal and oil fields.

The handful of peat enthusiasts with us today must be counted on to blaze the way to practical methods of handling peat as a real industry in this country.

The time, indeed, is now ripe in some sections to begin.

Litter. As we are a great agricultural and lumber-producing

*Read before the Eighth Annual Meeting at Duluth, Minn., Aug. 20, 1914.

country, straw, hay, sawdust, and shavings have up to the present well met the need for litter, packing material, and cheap paper stock; therefore, the peat-litter production has also been slow in development, regardless of the fact that peat litter is superior in many ways as bedding and for other purposes for which its fibrous nature and great absorbent power make it ideal. This industry likewise is awakening and may soon be expected to be on a practical basis.

Fertilizer Filler. The production of fertilizer filler is well started towards commercial importance, and although the plants for the most part are more or less experimental, yet the filler is being used by some of our best fertilizer producers and has been found to be of great value as an ammoniate and conditioner for mixed chemicals.

The use of peat in agriculture, both directly and indirectly, has in this country advanced farthest of any for which the material is adapted—in fact, is now squarely on the practical production stage.

Prof. W. T. Bottomley has shown wonderful fertilizing power with his bacterized peat, produced by breaking down raw peat with decay bacteria, such as are found in rotting bone, and then treating the peat with the Aztobacter type of nitrifying organisms, a process easy to render useful in a large way. Some of his experiments showed better crop production with 1 ton of bacterized peat to the acre of land than with 80 tons of manure. In somewhat similar manner prepared humus is also supplied and has shown results far beyond manure and much more permanent.

Prof. Homer C. Thompson has interesting data as to the value of peat or humus from cultivated fields in greenhouse work and his open field experiments will also be of marked usefulness to the agricultural community. He has charge of the co-operative work of the Federal Department of Agriculture and the American Peat Society.

The work is being done with the expectation of properly classifying the various agricultural types of peat and determining the most practical and economic way of getting the maximum in crop value out of such soils.

The bulk of our onions, lettuce, celery, mint, and many other vegetables are now raised on peat or muck soils, notably in New

York, New Jersey, and the Middle Western States. Properly drained and conditioned muck land is the most valuable in point of quantity and productive power for the crops mentioned and is selling in some sections at several hundred dollars per acre and giving most remarkable crop returns to those who go at this branch of agriculture with any degree of intelligence.

Land that can be rented at $25 to $50 per acre and can readily be made to produce as much as $500 to $1,000 in crop value per acre yearly is certainly worth while and should aid materially in solving the problem of lower food cost, which, by the way, is another story in the economics of supply and demand and the cheaper dollar.

To make the production of peat fuel economically successful in our country it should cost not to exceed $1.50 per ton to produce, to compete with coal at $3 per ton having about double the heat value of peat. To this must be added freight in the same proportion. Where coal sells at $5 or above the production of peat fuel is profitable. Perhaps the most economical way of utilizing peat fuel is with the aid of a gas producer located on the bog, converting the fuel into electrical energy and recovering ammonia and other by-products otherwise lost.

The process used for producing peat fuel needs to be one not dependent on weather conditions, which is the great drawback to most methods, rendering the output more or less intermittent and causing much variation in production costs.

Litter and filler production is also controlled in most processes now in vogue by weather and moisture conditions, so much so that is is really impossible to arrive at exact average-cost figures. From one season to another the cost of production may differ fully 100 per cent. This variation might be controlled in part by extensive gathering operations in a favorable season, so that during an unfavorable season the finished product may be made from the stock pile. What we really need are processes for continuous operation with less variation.

Along these lines some progress has been made, but in every case nature's help in dewatering proves so much more economical than other ways that it is usually essential to success.

To my mind the agricultural development of suitable peat or humus soil is the safest and sanest method of extracting real

money from this most interesting substance, and next to that comes its use as a substitute for animal manure as an organic fertilizer, a field in which we have yet much to learn.

We are fortunately in an age when money is available for experimental work, and the man with good ideas should have little difficulty in having them tried out to his satisfaction. It is in the province of the American Peat Society to encourage and further all such investigations and experiments without prejudice or bias.

It is hoped, too that the various agricultural stations will pay more attention to the value and use of peat or humus, and assist in rendering it more valuable, and not condemn its use without due investigation and practical tests. Peats vary so much in quality, too, that a proper classification will go a long way toward correcting this prejudice by enabling us to more correctly judge the qualities of the particular deposits under examination.

There would be a fortune for the inventor who could patent a device to make both ends meet.

The faster a man runs into debt, the more he gets behind.

Peat Lands in Minnesota and Wisconsin

*By Prof. John T. Stewart, Agricultural Engineer, University of Minnesota.**

Minnesota, like many northern areas, contains large tracts of so-called peat lands, there being no definite information on which to base an estimate of the total area. Attempts have been made at various times to state in square miles or acres the extent of these lands, but such estimates are mere guesses, usually based on the swamp-land reports of the United States land office. Consequently I will not make any attempt to state in figures the actual area of these lands in either Minnesota or Wisconsin, but will make the statement that the percentage of the area of these two States covered by lands that come under this classification is probably as large as that of any other agricultural area of equal size in the North.

Owing to the fact that there has never been any accurate land classification, there is always some question in regard to just what areas come under the general head of peat lands. In an extensive experience in looking up the reclamation of wet lands I have often found that large wet areas are locally known as peat lands, when in reality they are not peat but an ordinary soil covered with a thin layer of slough grass or other swamp growth which has fallen down and not been burned off. Such lands would no more come under a peat classification than a meadow where hay had not been cut after a heavy rain. This confusion in the classification of lands that contain a large amount of vegetable matter has lead to many erroneous statements in regard to peat. Oftentimes papers are written by local persons describing the work they have done and results accomplished on peat when in reality there is no peat in the immediate vicinity. This is one source of the various conflicting statements in regard to results obtained from peat lands often in the same community.

In the popular mind the term peat is often synonymous with

*Read before the Eighth Annual Meeting of the American Peat Society at Duluth, Minn.

swamp or wet lands, and the terms bog, moss, turf, and muskeg are applied to areas that are properly peat, the word muck being often applied to any black sticky soil regardless of the amount of vegetable matter contained.

Consequently the investigator in studying the agricultural possibilities of peat must take with a grain of salt general statements in regard to results obtained from such lands unless he has actually examined the lands in question, and this examination should be carried to some depth below the surface by borings or otherwise, for surface indications are often deceiving to the eye. A vegetable growth of three or four years lying on the surface in shallow water may give the general impression of an extensive peat area.

The peat areas in Minnesota probably cover all the different classifications of vegetable lands and are designated by practically all local terms used for such lands. In the southern and central parts of the State these areas are made up of various prairie swamp land growths such as sedges, rushes, and wire grass, different growths predominating in different localities. In the northern and timbered areas there are the Sphagnum or tamarack peats. Some of these marshes are fairly heavily timbered with tamarack or black spruce, and in other localities there are large open areas almost devoid of growing timber.

Consequently peat lands may be divided into two classes: First, the prairie peats in which there are no tree roots or down timber to interfere with reclamation; and, second, the timber peats in a marsh that is full of roots and down timber, even though standing timber is wanting.

The depth may vary from a few inches up to 25 or 30 feet, and some reports indicate that there are localities where the depth is as great as 50 feet. Twenty-two feet is the greatest depth the writer has found. The greater areas probably vary from 6 inches to 4 feet, large areas varying from 4 to 8 feet. The percentage of areas that are 8 feet or more in depth is comparatively small.

There is no accurate way to determine the depth except by actual borings. Some idea, however, can be obtained from the general topography. The shape and depth of lakes that do not contain peat formation will give some general idea of the conformation of a peat area in any immediate locality. As a general

statement, where the land is flat around a peat bed, the peat is shallow. If the land has steep banks, the incline of the bank will continue for some distance below the surface of the peat and the peat will be deep.

On a basis of depth the following classifications might be made: Shallow peat, with a depth of about 1 foot, or such that after drainage and settlement a deep plow will turn up the underlying strata, mixing the vegetable matter with the subsoil; medium peat, with a depth ranging from 1 to 4 feet, or such that ditches dug to the proper depth will reach underlying strata; deep peat, with a depth of 4 to 8 feet, the depth being such that only the deepest outlet ditches would reach the underlying strata; very deep peat, with depths of more than 8 feet. With this depth reclamation of the land by ditches and plowing would have little or no tendency to modify the soil.

A classification in regard to banks might be made as follows: Flat banks, with a slope of about 3 feet in 100; rolling banks, with a slope of approximately 10 feet in 100; hilly banks, with a slope greater than 10 feet in 100.

These classifications are more or less arbitrary and could be used only for the purpose of general description in reporting on peat lands in regard to agricultural improvements.

The consistency of these peat lands varies greatly even in the same locality. Some of them are very firm even when covered with water, and will bear the weight of a team. There are all graduations from this firmness down to almost a liquid consistency which will not support a man even when the water is comparatively low. This variation is due to the amount of silt that has been deposited in the formation, and to the nature, settling, and packing of the vegetable growth. Prairie peats of rush or wire-grass formation are firmer than those of timber or moss formation.

The color varies from a red or brown to almost black, depending somewhat on the vegetation from which the peat originated, the stage of decomposition, and the amount of water contained. Some of the mucks in an advanced stage of decomposition are so black and fine that it is hard to distinguish them from black mud. Decomposed muck when thoroughly dry will support a heavy load, but when saturated will often flow in a ditch.

So far, no great distinction is observed between the various grades of vegetable soils such as peaty soil, muck and peat. It has occurred to the writer that the following general classification would be satisfactory: A soil containing less than 50 per cent of vegetable matter might be considered a peaty soil; if a soil contains more than 50 per cent of vegetable matter, it might be classified as peat. When the vegetable matter is so thoroughly decomposed that it is granular instead of fibrous, it should be classified as muck when it contains more than 50 per cent of vegetable matter, and as mucky soil when it contains less than 50 per cent.

The mineral matter contained in these peat soils seems to depend on the mineral constituents of the surrounding high lands as we find some of these lands giving an acid reaction and others alkaline. Consequently we have the classification of peat lands as acid or alkaline, or in more popular language, sour and sweet. In some localities the reaction is slight, but in others it is quite marked, the acid or alkaline content being sufficient to affect growing vegetation. Deposits that have no natural drainage, and on which the rise and fall of water is due to wash from surrounding land and to evaporation, may become decidedly alkaline or acid, but this is exceptional.

The reclamation of peat land for agricultural purposes is one of the problems now facing those interested in the development of the nonproductive lands in Minnesota and Wisconsin. As in other States, until comparatively recent years nothing has been done with these lands, as they have been considered worthless. For this reason there is little real information on this subject. About five years ago one of the writer's assistants who was assigned to looking up literature on the development of peat lands for agriculture came into the office with a rather disgusted look on his face and stated that he had found all the modern literature was only a copy of what had been written nearly one hundred years ago, giving the impression that nothing new had been developed on this subject. To a certain extent his conclusions were correct. The literature of five or six years ago contained little of real value on peat-land development. Possibly we are not much farther along today, but the interest now taken in lands of this nature and the number of persons who are grad-

ually beginning the cultivation of these lands mean that the time is coming when information can be had and many of these lands will be cultivated profitably.

Present experience would indicate that peat lands formed of wild rice, cat tails, blue joint, etc., decompose readily and are therefore fairly easy to work up into productive soil, whereas the live sphagnum mosses require the removal of the surface covering of moss by burning or hauling away to prepare the land for agriculture. The former class is usually covered with a tough, rooty sod that requires two or three years for decomposition so it can be cultivated, and the removal of the moss in the latter is often a slow, tedious operation. Consequently there are difficulties in subduing any peat land.

One of the first requirements that is recognized by all is thorough drainage by either open ditches or underdrainage. There is considerable difference of opinion in regard to the advantages of each. There is also considerable difference of opinion in regard to the amount of water that should be taken out of a peat soil, some contending that it may be drained so dry as to become worthless, others that withdrawal of sufficient water to allow the land to be farmed in ordinarily wet seasons is impossible, owing to the fact that horses will mire on cultivated peat. Both the above statements are undoubtedly true in certain localities, either result being due to the formation of the peat deposit, underlying strata, etc., and it is hoped that in the near future, before any work of improvement is done, it will be possible to examine a peat deposit and decide definitely which of these conditions is going to prevail, and to plan the reclamation work accordingly.

Another difficulty that has been encountered in the development of peat lands is due to the fact that the ordinary agriculturist works along certain lines and insists on raising certain products common to his locality, not always taking into consideration the land and general conditions under which he is attempting to produce his crops. When he does not meet with the success he thinks he should, he becomes discouraged, ceases to cultivate that class of land and condemns it in general terms. The agricultural communities have not learned that peat lands, owing to the presence of water, are not a completely formed soil, that

if they are to be productive they must be treated in such a way as to aid in their decomposition and the formation of a crop-producing soil, and that results should not be expected the first year.

In the earlier days of development of swamp lands throughout the northern parts of Illinois and Iowa a profit-producing crop was not expected until the third year after drainage, regardless of the cost of drainage improvement. The wild swamp lands were broken the first summer and left without a crop. The second season they were usually planted, but the object was not the production of a crop so much as to make a necessity for the cultivation of the land, that it might be worked up in a proper condition to form a seed bed the third season. When we consider that these lands were not vegetable lands except in the top 6 or 8 inches which was full of roots of growing swamp plants, we should not expect a profitable crop to be produced the first season after drainage on land covered with 12 to 36 inches of dead vegetation.

The writer, as a drainage engineer interested in the development of swamp and wet lands for the past ten years. has been watching closely the development of peat lands for agricultural purposes. Although reliable new information is coming slowly and as yet there does not seem to be any way of drawing definite conclusions out of the large mass of information that is available, for seemingly as soon as a fact is proven on one tract it is almost immediately disproven on another, nevertheless the amount of information is rapidly increasing, and I believe the time is near at hand when certain definite statements can be made in regard to these lands and their agricultural possibilities when developed.

In the development of these lands all attention should not be given to the production of crops whose satisfactory yield has become well established on mineral lands, but a certain amount of experiment and investigation should be carried on with reference to the development of new crops that are suitable to lands of this nature, and to the use of the by-products of these lands for various commercial purposes that will tend to pay part of the cost of development. Sphagnum moss has a commercial value in a variety of ways. The production of wire grass in some localities is as profitable as the raising of other crops, the product being used for packing material, carpets, rugs, etc., and there are

undoubtedly a number of agricultural products that are not considered as crops at the present time that could be profitably produced on peat lands. Consequently the development of these lands should be along lines of production that will be most profitable in the end.

EXPERIMENTAL PRESSING OF WET PEAT.

(Translated from "Det Norske Myrselskap.")

A new method of pressing water from peat was being tried out in Germany during the summer of 1914, when the war broke out. The raw peat with its 85 to 90 per cent of water was mixed with a certain per cent of dry peat which was crushed into small pieces. The mixture was subjected to slow, gradually increasing pressure in a combined band and roller press. The dried, partly pulverized peat in the mixture made it possible for the water to form pore-like channels through the mass of wet peat, and under the increasing pressure the water ran out from the peat.

It is claimed that this method will lower the moisture content of the wet peat to 60 per cent in 15 minutes. The peat with this water content can be used without further drying, as fuel, it is claimed, in peat-gas producers, or as raw material for manufacturing briquets. Besides the advantage that the added material is peat, this method of partly dehydrating wet peat is both cheap and simple.

A band press of this type with a breadth of 1 meter (39.37 inches) and a length of 15 meters (57.5 feet) is able to press 930 tons of raw peat in 24 hours, bringing down the moisture from 85-90 per cent to 60 per cent. The power required for the press is 25 horsepower. Besides this, 10 horsepower is needed for operating other apparatus. The number of men required is very small.

The method and the machinery and apparatus are patented in Europe and America.

Peat Briquetting

*By J. McWilliam, M. D., London, Ont.**

To produce a good commercial peat briquet three operations or steps have to be taken, as follows: First, harvesting or collecting the peat from the bog; second, drying the collected material, and third, forming a briquet that will be hard enough not to pulverize on handling and that will resist moisture.

After a bog has been cleared it has been found that by harrowing the surface, large quantities of peat in the thin surface layer will dry down to 25 per cent moisture in two hours on any warm day. Now to obtain this dry material and leave behind the wet peat, that is, to separate the dry from the wet, is the first problem. And I believe that only one mechanical device can accomplish this, namely, a suction fan. The rate of revolution of the fan in relation to the size of the opening in the mouthpiece controls the weight of the particles of material that will be drawn into the fan. We have successfully used a fan collector for eight seasons. Its cost of operation is low, and the procedure in its use takes advantage to the full of the powers of nature—the sun and wind—to do the expensive and difficult task of drying out the water from the peat. The water content is reduced from 90 to 25 per cent at no expense except that of harrowing the bog and passing the collector over it. The collector operates just as a vacuum carpet sweeper works in cleaning a room—and thus the expense of handling the water in the original bog is avoided. The peat is delivered into a large building as a fine dust, containing about 25 per cent moisture, which is important, as by this means the difficult and costly operation of grinding the peat is avoided.

By contrasting this method of collecting with the older plans of harvesting, drying, and grinding the peat before briquetting it, one can readily see the great advantages of the plan outlined. The water is not handled at all, but is removed by the sun and

*Read before the Eighth Annual Meeting of the American Peat Society at Duluth, Minn. Because of Dr. McWilliams' inability to be present, the paper was read by Prof. C. A. Davis.

wind. The harrowing and collecting reduce the peat to a powder, no grinding being required, and the whole operation takes place in a short time—in half a day or less if the weather is good. We have found that we can work 100 to 130 days at collecting the dust in each season. The exact cost per ton of harrowing and collecting the peat is not quite certain, but after eight seasons of experimenting, the writer believes it to be well under 50 cents per ton,—a very cheap method.

The second step consists in reducing the moisture content from 25 to about 15 per cent, which is the favorable moisture content for peat that is to be briquetted. Many driers for this purpose have been devised. We are now using a steam-plate drier, such as is used by oatmeal mills to dry oats, but we have had to modify this drier to suit peat. We have found it convenient and effective and cheap to operate, but it lacks one great feature that would add to the efficiency of any drier, namely, it does not shower the peat dust enough. The writer believes that the most effective drier would be a modified American process drier, the current of hot air being supplied from steam pipes. Anything hotter than steam drives out some of the combustible gases, and is constantly setting the dust on fire. I can give no exact cost per ton of drying peat in this steam-plate drier, but the operation is not expensive. The running of the drier requires little power, and seems to take little from the efficiency of the boiler, as it exhausts back to the boiler direct and needs no attention at all. Twenty-five cents per ton is an outside estimate of the cost of drying the peat from 25 to 15 per cent moisture.

The third step in this process is that of briquetting the dried dust. Many presses have been devised for producing good fuel briquets. The writer has had experience with three kinds: First, a punch press which formed a cake or briquet by a sudden punch on the dust contained in a die. This press will always fail, because it does not allow for the escape of the air contained in the dust. The briquets made in this type of press soon slack, and if the briquet receives several strokes of the piston after the air is out, the die block soon breaks from the crystallization of the steel. The die wears out rapidly from the cutting effect of the peat dust. Of course, new discoveries in steel and different alloys may make possible an improvement in this form of press, but the

writer believes that much more effective presses exist. For several seasons we have used a Milne rotary press. It did good work when it got dust of an exact moisture content—6 to 12 per cent—but the press was hard to lubricate. It was defectively built and soon broke, and to feed it uniformly with material of just the right moisture content was impracticable. Although we made and sold 1,500 tons of good briquets with it, the press left much to be desired.

We have this season built and installed a press devised by the American Briquet Machine Company of Chicago, Ill. This press introduces an entirely new force into the art of briquetting—the use of a gasoline explosion cylinder. The process of compressing the material into briquets is divided into two parts or movements. The first movement is made by gear wheels and goes on slowly. It exerts a pressure of 10 tons on the three briquets made simultaneously with this machine. The piston advances slowly and permits the air to escape as it compresses the powder in the mold. When the pressure of the gear wheels is at its maximum the explosion of a charge of gasoline takes place in the gas cylinder, which in turn drives out the piston, and a pressure of 450 tons is exerted on the three briquets. By this means very hard, dense blocks weighing 1 pound each are formed. The cost of operating this press is not yet certain, though much experimental work would point to a cost of about 20 cents per ton. Of course, all figures given in these estimates take no account of amortization costs, nor of the original capital required, taxes, etc., but refer only to daily running expense, as labor, oil, fuel, gasoline and power.

The subject of peat briquetting is one of great scientific and commercial interest. The writer has devoted much time and money to solve this problem in the face of an almost unanimous verdict that briquetting could not be done profitably, and after eight years of careful work and observation he believes that briquetting offers the easiest solution of the peat-fuel problem in this climate. We have visited the other peat plants using all the other methods, and have eagerly looked for a plant that had a method that was commercially successful, so that we could adopt it, but each visit to the other plants only convinced us that

our own plan, if fully matured, was more to be desired and offered greater chances of success.

When one considers that 100 pounds of peat in the bog contains 90 pounds of water, and that only 12 pounds of good fuel (20 per cent moisture), worth, at $5 per ton, 3 cents, can be obtained from it, it is then easy to see that no method of artificial drying to remove all of the water from peat, can be successful. The good offices of the sun and wind must be depended on largely to do the drying. The only hope of doing without them would be by using mechanical dewaterers, and we know of none that have shown that they are at all useful. Besides, all mechanical dewaterers require the handling of the large quantity of water, which the writer believes to be too great an expense to permit commercial success. The writer does not criticize any other methods, nor does he recommend his own further than is warranted by the facts as far as ascertained by him.

PEAT—ITS FRIENDS AND ENEMIES.

(Communicated to "Commercial Fertilizer," July, 1914.)

We note in the Year Book, 1914, an article on "Organic and Mineral Nitrogen." So much that is like this is being said that we, as one of the friends of peat, feel disposed to say a few words:

This article says that organic nitrogen includes blood, tankage and peat; that the nitrogen of blood nearly all becomes available and that of peat only about one-third becomes immediately useful and that a farmer who buys a fertilizer of which the nitrogen is derived from peat, is paying three prices, as his crop will take up only one out of every three pounds. We take it that the writer of the article wants to say that the other two pounds of nitrogen are lost and are no good, as he later on refers to peat again and there is nothing said to indicate that such is not his belief; in fact, he repeats this statement later on. While we have not the pleasure of knowing this gentleman, or what his knowledge of peat is, from his statement we infer that he has had actual experience of using peat, muck or humus in a fertilizer. We add the word humus, as peat or muck is generally called that when prepared for fertilizer material, as he makes such positive state-

ments and seemingly knows so much about its uses as a filler, etc. It may not be proper for us to call this gentleman an enemy of peat, but we certainly cannot call him a friend of it, and it is just such articles as this referred to that is depriving the agriculturist of a good and cheap plant food.

As the manufacturer of a fertilizer hesitates using peat in his goods, with the use of which he could often cheapen the price of his fertilizers, he fears condemnation from just such articles as the one above mentioned.

There are extensive peat fields in the State from which this article is sent out, as well as adjoining States, that with the aid of such writers, instead of "knocking," would develop and give the farmer, whose friend these writers hold to be, probably the best and cheapest plant food that could be possibly applied to soil and will do more in a cheaper and quicker way to reclaim exhausted lands than any other way such exhausted lands can be reclaimed. We may be considered bold for making such a statement as this, but as friends of peat, we will try and give a reason for these statements.

Peat Test, Iredell Farm, 1909.

CORN.—150 pounds acid phosphate; 25 pounds manure salt; 150 pounds peat. Yield, 22.5 bushels shelled corn.

Same, with dried blood in place of peat, 64 pounds blood. Yield, 27.6 bushels shelled corn.

Unfertilized Plat. Yield, 11.6 bushels shelled corn.

COTTON.—200 pounds acid phosphate; 50 pounds manure salt; 350 pounds peat. Yield, 1,025 pounds seed cotton.

Same, with dried blood in place of peat, 71.1 pounds dried blood.

Unfertilized Plat. Yield, 670 pounds seed cotton.

One hundred and fifty pounds of peat contains 4.8 pounds of nitrogen, as against 8.96 pounds of nitrogen in 64 pounds of blood, in the corn tests; and 350 pounds of peat contains 9.52 pounds nitrogen, as against 9.95 in 71.1 pounds of blood in the cotton tests.

Granting, as the writer of this article referred to says, that the nitrogen of blood nearly all becomes available, and we will add that it is probably the best form of nitrogen that can be used as a plant food, when the above test made by perfectly disinterested parties is studied over, it will be seen that peat gave a great

deal better results in both tests. This certainly does not look as if the nitrogen of peat was only one-third available and not an actual plant food. If the per cent of nitrogen of the two articles used, blood and peat, was the same, and the results, the measured contents of the corn and cotton, were the same, then it would indicate that the two sources of nitrogen were of equal value; but when the results are figured in proportion to the amount of nitrogen supplied by each substance, it indicates that the measured results are about in value four to three, in favor of the humus. This gain we account for in the actual humus of the peat. Careful analysis shows that this humus runs about 75 per cent, which we claim is as good and valuable a plant food as any of the other three substances generally known in a complete fertilizer, viz., nitrogen, acid phosphate and potash. It is our claim that this actual humus does more than actually feed the plant, as the test above referred to would indicate. We maintain that a soil that is annually treated with a fertilizer that contains a good per cent of humus will eventually build that soil up and make exhausted soil almost as good as virgin land. We claim this on the theory that this actual humus inoculates the soil with bacteria similar to those that legumes add to the soil when plowed under.

In claiming all this that we do in peat, the claim is not based entirely upon this one test referred to, but on numerous actual growing results that are taking place yearly with actual users of a fertilizer containing a good percentage of humus.

We note this writer of the article referred to, in commenting further, says that peat is generally considered a nuisance by the owners, etc. We, ourselves, own in the State of Illinois several hundred acres of peat land, that we cultivate and annually grow a large crop of corn on. Since we have cultivated this land, for some ten years past, we have never raised less than 60 bushels of corn, and from that to as high as 90 bushels per acre. This is not any prize acre business, but an actual field of from 200 to 300 acres, and in giving this average, it is in general of the entire lot. If land giving this kind of a yield is to be considered a nuisance, then we wish we had a lot more of it, as we do not think there is any land outside of a good peat that will equal this average.

Respectfully,

JOHN WIEDMER.

Springfield Filler Co., St. Louis, Mo.

How to Manage a Peat Fire

By Mary Housekeeper, Urd, Norway.

(Translated from "Det Norske Myrselskap," January, 1914.)

It has been cold all the fall and the coke supply is shrinking now at Christmastime. The coke is extremely expensive, too. Have you tried peat in your stoves?

This is a very important question. I know many who have tried the peat and their opinions differ. Some say it is very satisfactory, others that the peaty odor can be smelt all over the house and that the light ash from it flies around everywhere as dust. Of course, these different opinions do not depend on the peat, but rather on the local conditions where the peat is prepared and used. One stove, also, may be more suited for peat-fuel than another.

I would suggest that every one make his own tests in order to be on the safe side. The peat is reported to be a cheap fuel. It can be kept burning the day round (24 hours) in a common stove if properly attended to.

I will try to lay down a few rules for starting and keeping peat fires, for those who want to try the fuel. The peat is kindled in the same way as the coke in ordinary use, with some wooden kindling; the peat, however, requires less wood than the coke. When the peat is well ignited, say about five minutes after the kindlings have caught fire, the draft is turned down to about one-fourth. This, of course, can be done only if the stove is in good or normal condition. If the peat is of good quality it will be smouldering all night, and in the morning the stove requires only to be filled up with fresh peat to start the fire again. The ash may be removed in a covered receptacle to prevent its flying about, and it is also advisable to sprinkle it with water in order to prevent scattering.

Let us not forget that we can produce the peat ourselves, and that we have plenty of peat-bogs in Norway. Self-help is not to be disregarded. Don't think you know it without trial. One's own experience is the best basis for judgment. Therefore start in making a test and figure out the relative fuel value both of peat and coke.

The Production and Use of Peat Fuel in Russia

*By Gr. Lisitzin, Ph. M., Dipl. M. E., Riga, Russia.**

There is no other country in the world where such quantities of peat fuel have been produced as in Russia. Peat fuel is used in the household, for industrial purposes, and for locomotive firing. Much has been heard of the peat-fuel production of other countries, while nothing has been said of the peat produced in Russia. There have been constant attempts elsewhere to introduce new machines and new methods, to which wide publicity has been given by the inventors and manufacturers; Russia, however, had a practical engineer, the late Aleph von Anrep, Sr., who is looked upon as the founder of the Russian peat-fuel industry.

The widely advertised machines and methods have often accomplished nothing more than to consume vast sums of money, at the same time increasing but little the output of fuel, owing to the increased cost of production. In Russia machines have replaced manual labor in the production of peat fuel, but, up to the present time, mechanical excavators have proven impracticable for use there. However, it is to be hoped that machines that may be used in Russia will soon be produced, because without mechanical excavators and spreading machines there is a great deal of hand work connected with peat fuel production.

It is difficult, and, I might say, impossible, to state the amount of peat fuel produced in Russia, for great quantities are made and used for household purposes of which there is no record. So far as is known, in 1908, there were 8,200,000 short tons produced, which is an enormous amount; since that time there are no exact figures available. The railroads have used less peat fuel in recent years than formerly, but so far as one can judge, the total amount used has steadily increased.

The method of production has remained the same as that which has been in use since peat machines with mechanical elevators were adopted. The men dig and shovel the raw peat onto

*Read at the Duluth meeting, August, 1914. Translated by G. A. Dye, Washington, D. C.

the elevator, which delivers it to the machine. After the raw peat has been macerated by the machine, which also forms it into blocks, the blocks are conveyed on small cars to the drying field on the bog, to dry in the open air. In the Russian climate the peat fuel is not ready for use until after it has been allowed to lie in the stacks for one year; this is important, as fuel of uniform quality is thus obtaned.

I shall not go into the details of peat-fuel production in Russia, for they are well known, but I should like to speak of the elevators and peat machines that are used. The elevators are built according to the design of Engineer Hendune; have attained great perfection and have proven to be very durable.

So far as peat machines are concerned, a great many types have been constructed and every inventor wishes to emphasize the merits of his own machine. The machine, however, must advertise itself and the one that is most widely known for many years is the best.

Such a machine was developed in Russia by Engineer A. von Anrep, Sr., several years ago, and, even at the present time, the good points of the machine must be acknowleged.

Although one has acknowledged the importance of a good peat fiber cutter or macerating machine, Engineer Hendune, an old acquaintance of Engineer von Anrep, Sr., invented a machine which is now very widely used, although one still sees many of von Anrep's machines in use.

Official testimonials from peat factories speak very favorably of the Hendune machines, for they make peat bricks of great toughness and density.

If the quantity of peat now produced in Russia is considerable, one may expect that it would surely be greater if the present method did not require so many laborers per unit of production. A scarcity in this respect has been felt in Russia during recent years. Of course there are enough laborers, but the period for peat-fuel making, which runs only from about the beginning of May to the end of July, is too short; during this time the peat supply for the year must be gathered. It is difficult to procure laborers for this short time, just when farm hands are needed everywhere. The time for gathering peat cannot be lengthened, for it is well known that the sod or brick falls to

pieces, or becomes spongy, if it freezes when it contains a greater water content than 40 per cent. My own laboratory experiments with small quantities have shown that one can get good, dense bricks, under certain circumstances, from peat that has been frozen with 80 to 90 per cent water content. There will soon be printed an article on this subject, but one must not expect accurate results until practical tests have been made.

Another way to prevent the deleterious influence of freezing in peat bricks naturally is to use powdered peat, although this has its weak points.

The necessary number of laborers needed in Russia for the production of 3,600 short tons of air dry peat, during the past season, is 30 men and 16 women. If one desires to gather great quantities of peat, one can engage a large number of laborers for a short time in a locality particularly rich in peat, but this lessens the natural peat production. If some one were to invent a practical excavator, it would be very useful. I have seen many excavators at work and can say that they are very good for certain bogs, but I should not like to recommend any one of them for general use in Russia, for bogs can be found that yield very good peat, which is made up of one-third to one-half tree remains. The Anrep excavator is said to be successful in Canada, but unfortunately I have not seen it at work. Of the European excavators, for bogs free from wood, those of Wielandt and Ekelund are good, but are scarcely suitable for use in Russia.

It must not be forgotten that the harvest time each year is short and for this reason the cost per ton of production, including taxation, is large. I shall presently give data showing the cost of making peat fuel in Russia. The figures are from a peat-fuel factory, for the year 1913. It produced about 43,000 short tons of peat. The price is that of peat fuel stacked on the field for the winter.

To this must be added the cost of the raw peat itself and that of the fuel consumed to generate 35-40 effective horsepower per hour.

One short ton air-dried peat (25 per cent water content), costs:

For digging the peat, machine work, and laying out on drying fields, per short ton	$0.572
For work on the drying field and stacking on the field	.180

Engine man	.023
Tools, oil, etc.	.058
Overhead charges	.067
Amortization	.187
	$1.087

I have intentionally omitted the amortization for the peat bog as that varies with local conditions; similarly with the cost of power, in which the cost of the fuel plays the most important part.

The price of labor is constantly rising; in 1912 it was over 2 cents cheaper for each of the first two items.

In Russia large electric power plants are being built very near the peat deposits. One such plant is in the vicinity of Moscow, which will have an annual capacity of 100,000 tons of peat fuel. Russian peat is good, and one may well be satisfied with the machines, for the weight of a cubic sagen (12.7 cubic yards) of air-dried peat is between 8,660 and 10.450 pounds.

Riga, in European Russia, May, 1914.

Opportunity seldom knocks at the door of a "knocker."

Between two evils, choose neither.

Peat and Its Products

By Vice-Consul H. Nixon, Newcastle-on-Tyne, England

A process for drying peat, which promises to be of great commercial utility, has been invented in Newcastle. The process is now in use in County Kildare and on the Lochar Moss at Rachs in Ireland, and near Dumfries in Scotland. The results so far are claimed to be of a gratifying character, and strengthen the hope of making peat a commercial commodity.

Peat is a spongy substance, composed generally of mosses and aquatic plants in different stages of decomposition. It covers about 2,831,000 acres of Ireland, one-seventh of the entire surface of that country, and the deposits in the gross are estimated to contain 39,972,000,000 tons of fuel of the value of $4,250,000,000. Scotland and the far north down to the borders possesses great deposits of peat, and in England and Wales there are some 6,000,000 acres of deposit. In the Newcastle consular district there are several extensive deposits, in the neighborhood of Consett, 20 miles, and Scaleby, about 60 miles, distant from Newcastle. The apathy shown in this country as to the utilization of this great natural resource may be attributed to the fact that coal is so plentiful and that the paper-making industry has declined to a great extent, the supplies coming mostly from abroad.

The Many Uses of Peat.

It is interesting to consider what can be made from peat. First of all there is peat fuel and peat charcoal, and in the making of these such by-products as naphtha, sulphate of ammonia, acetic acid, tar, and paraffin wax. Then there is moss litter, already an important industry upon the Continent; manure, preservatives and sheep dips, paper, cardboard and mill boards, disinfectants, artificial wool, surgical wool, and filtering and absorbing material.

When carried out on a large scale the low distillation of peat yields a profit of $275 per 100 tons, and the principal resultants are some 35 tons of peat charcoal and 1¾ tons of sulphate of

ammonia. It is from peat charcoal that the carbon pencils for the electric arc lights are obtained, and of these Germany has the exclusive supply at present. Peat charcoal, too, promises to play an important part in overcoming the smoke nuisance, and it has recently been used extensively and successfully in the form of briquets for smelting iron ore. Peat can produce an excellent quality of gas for lighting and power, and the value of the fuel as a producer of electricity has yet to be considered. At the Felling shore paper mills (near Newcastle), an excellent brown paper, waterproof, has been made from an 80 per cent mixture of peat. This paper could be bleached white. Peat fiber is an excellent binding. In this connection it may be mentioned that experiments in brick and earthenware making, the peat being mixed with proper kinds of clay, have had promising results.

As to its health-giving qualities, it is used in medicine for antiseptic wools and dressing, but its chief value to the physician lies in its employment for peat baths. Properly used, a peat bath is invigorating. Often workmen employed in the peat fields will have a peat poultice applied to some wound, this being considered locally as one of the best healing remedies that can be used.

A man never realizes what fool ideas he has until after he builds a house according to his own plans.

The less security you have the more easily you can borrow trouble.

Motor Spirit From Peat

*By Dr. W. R. Ormandy, D. Sc., M. I. A. A.**

The numerous deposits of peat which cover such large areas of the world's surface have for many years proved an enticing field for the chemical and mechanical investigator. Although peat deposits are found in a tremendous number of districts it may be stated as a general rule that they flourish most in damp climates. Unfortunately the bulk of the peat which occurs in nature contains 80 to 90 per cent of water, and the problem of removing this water in a commercially economical manner has hitherto defied solution. Most people are familiar with the thin squares of peat which are used in some country districts, and particularly in Ireland, as a fuel. These peat blocks are formed by cutting out the peat with a spade and stacking the wet material so that it dries during the summer months. Such an operation is, of course, utterly hopeless when it comes to the question of dealing with thousands of tons.

Mr. T. Franke, who has worked on the peat problem for a number of years, claims to have made the discovery that peat as dug out of the earth is exceedingly amenable to mechanical-pressure filtration after it has been heated for a few minutes to the temperature of boiling water. Earlier attempts to deal with the peat slime by ordinary or modified filter presses proved a failure owing to a number of causes. Some peats were so colloidal that they immediately blocked the filtering medium employed, others could be dried only in layers so thin that the work of handling and the cost of the presses became prohibitive. It is to the nature of the press employed that Mr. Franke has devoted the greater part of his attention. He found that it was impossible to dry adequately a given peat in layers exceeding a certain thickness; thus if a filter press chamber were employed about 15 inches in diameter and 14 inches deep provided with a porous top and bottom it would be found that the peat left in the cylinder after applying pressure was dried, say 1 inch from the bottom and 1

*From The Autocar, August 8, 1914.

inch from the top, but remained wet in the middle. The final form of press employed by Mr. Franke consists of a series of concentric steel rings covered on the surface with a number of layers of perforated steel sheets and gauze, the interstices in which serve as a means for carrying off the water when the peat lying between the cylinders is exposed to pressure. The distance between the concentric rings is approximately 6 inches, which means, of course, that the greatest distance that a water particle has to travel is 3 inches, as there is a porous surface on each side of each ring. The pressure is applied to the peat mass by an ingenious arrangement consisting of a steel ring provided with short wire brushes, the diameter of the ring and brushes being such that it forms a peat-tight movable piston moving between the concentric cylinders. By making use of this arrangement it is possible to employ very deep cylinders, which is a great advantage compared with the employment of the ordinary type of filter press, which is expensive in first cost and in labor of manipulation.

The operation consists in passing the peat from the bog through a rough grinder in order to render it more or less homogeneous, transporting the ground product into a preheater which may consist of a vessel rotating on trunnions, into which steam under pressure is allowed to enter. With steam at 60 pounds pressure five minutes suffice to raise the peat to the required temperature. The hot pasty mass is then dropped into the filter press chamber, where it is exposed to a pressure amounting ultimately to 100 pounds per square inch. The peat mass entering the press contains approximately 90 per cent of water, and, generally speaking, it may be said that the contents of the press are reduced in thickness in the ratio of 7 to 1, that is to say, in a press 7 feet long there will result a cake 1 foot in thickness. In the large press the whole operation of filling, pressing, and emptying can be carried out in half an hour. The resulting cake was quite hard, could be stacked in any required height, and has been found to contain 30 to 40 per cent of water, depending on the nature of the peat employed. Such cakes subjected to air drying would be reduced to about 25 per cent of water when they would appear to ordinary observation to be absolutely dry.

When stating that in a press 7 feet in length there would

be recovered about 1 foot of pressed dried peat, it is assumed that the peat as originally dug from the bog contained about 90 per cent of water and the finished pressed goods about 33 per cent of water. The following table will show how very rapidly the weight of material to be handled is increased by any diminution in peat contents of the bog material. From the last column it will be seen that if the raw peat contains 20 per cent of dry contents it is necessary to handle 3⅓ tons to obtain 1 ton of pressed dried peat, whereas with only 10 per cent in the original peat it would be necessary to handle 6.7 tons to obtain 1 ton. Mr. Franke tells us that his experience with English and Irish peats points to an average content of 15 per cent in the moor substance, which necessitates the handling of 4.4 tons to obtain 1 ton of pressed dried peat.

Dry contents of original peat. Per cent.	Weight ratio of original to pressed dried peat.	Tons to be handled for one ton of pressed dried peat.
10	100:15	6.7
15	100:22.5	4.4
20	100:30	3.3

The question which naturally arises in the mind of the practical observer is that regarding the mechanical behavior of the material forming the filtering surface on the steel cylinders, and this is a question which can only be answered by actual tests and experiments. I have devoted considerable space to the description of the process in so far as it applies to the drying of peat, because those interested in this subject will be aware that the crux of the problem lies therein. Once having proved it possible to obtain peat with 20 to 25 per cent of water, the value of the finished product and the number of its applications are well known.

Utilization of Dry Peat.

Peat is frequently found in the largest quantities in districts where coal is not available, and the discovery of adequate means for drying peat at a reasonable expense would open up entire districts to new industries. Such peat can be employed in the same way as coal for the ordinary purposes of power production, either by burning directly or for producing gas. Mr. Franke finds that

on distillation at about 800° C. he obtains from his pressed dried peat a charcoal or coke (for it is intermediate between these two products in its nature) which is admirable for many of the purposes for which the most expensive charcoals are employed. Owing to the low content of sulphur it has been found that such peat coke is better than the finest coal coke for the melting of high-class steel, and, made at a suitable temperature, peat coke has proved equal, if not superior, to the finest charcoal for the manufacture of blister steel and for case-hardening purposes.

During the distillation of the peat considerable volumes of gas are given off, probably sufficient to produce all the power required on the plant, and these carry with them water and tar which separate out in the first condenser. This tar, which is brown in color, is quite limpid and lighter than water. It is stated to form 6 per cent by weight of the peat employed in the still, such peat being assumed to have 25 per cent of water content, that is, to be thoroughly air dried. Leaving the first condenser the gases pass through a further cooler and a washing tower, in which the ammonia is absorbed and the gases pass on to the gas holder, where they can be measured.

Tar.

Of the tar, forming 6 per cent of the weight of the peat, it is stated that two-thirds can be recovered in the form of a colorless motor spirit boiling below 180° C. by the ordinary process of fractional distillation and washing. I understand that this spirit contains little unsaturated hydrocarbons, and that it behaves in all respects better than high-grade petrol when employed on a motor car with an ordinary carburetor. The remaining one-third of the tar is recovered in the form of heavy oil and pitch; the heavy oil, boiling between 180° and 250° C., would form an admirable fuel for Diesel engines, and investigation may prove that it is suitable for splitting up into a further quantity of motor spirits and other products. Creosote can also be obtained in comparatively small quantities, and methyl alcohol, that is, wood spirit and acetic acid, are both produced and would be recoverable in a plant working on a commercial scale. It is well known that peat contains, as a rule, more nitrogen than coal, and this in a form more readily convertible into ammonia than is the

nitrogen of coal. I am told that the ordinary process of distillation above described results in the production of about 80 pounds of sulphate of ammonia per ton of peat distilled. This figure seems high, being almost equal to the yields with average practice on Mond's system of coal distilling, but possibly the high results are accounted for by the fact that the peat gives up its nitrogen more readily than coal, and that there is considerable water always present.

I was much impressed by the readiness with which Mr. Franke admitted the impossibility of giving general figures as regards the yields of dried product and in other respects. He pointed out how much peats differed from one another, and how in consequence accurate results could be obtained only by actual tests on the peat concerned. It would be well if some of the people dealing with coal were equally ready to realize that coals differed in their behavior as much as peats. The development of the Franke process will be watched with great interest; the results so far obtained certainly seem to justify a trial on a larger scale.

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EDITORIAL

Addition to the Journal's Staff. It will be of interest to all of the readers of this Journal to learn that Mr. C. T. Robertson, of Mt. Rainier, Md., has consented to act as Assistant Editor. Mr. Robertson has had a very considerable editorial experience, and is as well a thoroughly trained literary man and a writer of ability. It is hoped that with this addition to the working force, the dates of publication of the Journal will be much more regular than has been possible up to this time.

Peat Condemned without Trial. The men who produce dry peat for mixing with other substances for fertilizers, and for stock foods, frequently report that those in authority who control the inspection of such mixtures as are sold to farmers, reject those containing peat, and forbid their sale in the region under their jurisdiction. Such prohibition is unfair in most cases, because it is based on misapprehension, or, sometimes, it is to be

feared, on prejudice; or on insufficient and purely theoretical data. The only fair way to learn whether or not peat is a good substance to use for fertilizer or to give to cattle in mixture with other substances, is to give such mixtures fair tests on a sufficiently large scale to make the results convincing. In making such tests the peat used in them should be of the same origin as that barred out of the markets by the testing officials. Instead of taking such methods, it is not uncommon for officials to refuse to make tests on the grounds that they have no funds available to conduct large scale experiments. They continue, however, to refuse to open the markets under their control to a material, which, in some authentic cases, has been shown to have a high value for the purposes for which it is used. Why should a substance with so good a record as peat has behind it, both here and in Europe, be condemned before it has been really tested in comparison with similar or inferior substances whose use is authorized? Why not make some real tests of peat?

Do Oils and Waxes Occur in Peat? Who has seen anything in the nature of a natural occurrence of petroleum, or of any oily substance resembling petroleum or of paraffine wax in peat in the United States, or in this continent? Both oils and waxes have been reported from some of the older types of peat bogs in Europe, but there seems to be no record of such hydrocarbons having been found in America. The nearest approach to it that has been noted are the resin and pitch which have been found in peat containing remains of coniferous trees. The editor would be pleased to get evidence that oily and waxy compounds have been found in peat beds in this country.

Possible Gas-producer Tests of Peat. The manufacturers of a gas-producer designed for bituminous fuels which has been in successful commercial use for some years have recently announced their intention to make a series of tests of their producer with peat as fuel, if they can get the fuel. At least a carload of peat is needed. Preferably the peat should be in cut form, as dug from the bog, and only partly dry. Good peat, well decomposed, is needed. The testing plant is located in Jersey City, and if any one not too far from that point can furnish a carload

or so of peat in the condition mentioned, a word to the Editor will put him in touch with those who need the peat and the tests can then be made.

The Boston Humus Company is the name by which the reorganized Boston Fertilizer Co. will hereafter be known. At the annual meeting of the stockholders A. William Sperry, of New Haven, Conn., was elected president and John Olsen manager. The plant and offices of the company are located at East Lexington, Mass. It is reported that important additions are to be made in the equipment for preparing peat for fertilizer purposes under the new management, so that production will be increased and its cost diminished. The bog controlled by the company has been the seat of a number of peat fuel operations, one of the earliest of which was that of the late Thomas H. Leavitt, who conducted a peat fuel plant there for a number of seasons from 1865 on.

Peat Dust for Packing Fruit. According to authentic reports from the Canary Islands, before the present war began some 5,000 metric tons (metric ton equals 2,204.6 pounds) of peat mull or dust were imported annually into the islands for packing material for the more delicate and easily destroyed fruits, such as tomatoes. This material is well suited for the purpose, as it is light in weight and very absorbent, and quite free from fungi of all kinds that produce decay in fruits. The fruit was wrapped in paper and then packed in the dry peat. The peat sold in the islands for $10 to $11 per ton. Up to the present writing no attempt has been made to produce peat mull in the United States, so far as can be learned. This is a good time to start a litter and mull plant.

Peat Fuel Producers. How many peat fuel producers were at work in the United States in 1914? The Secretary of the American Peat Society reports that he knows of none. The Editor learned by accident of two, one in Michigan and one in Maine, who were at work on a small scale last year, and a third, also in New England, who claims large production. There were possibly others, and if any of the readers of this note know of such, they will confer a favor on the Editor by sending him the ad-

dress of the operator, and any other information relating to peat work done in 1914.

Peat Fiber. For more than a year past, samples of the so-called "peat fiber" have been sent the Editor, with inquiries as to possible sources of supply in the United States, and as to the origin of the material. A brief note about this fiber may therefore not be out of place at this time.

Peat fiber is a fine, dark brown, rather silky fiber found in the more poorly decomposed parts of some Sphagnum, or moss, peat beds. The relatively small amount of "peat fiber" which has reached this country doubtless came from Germany and Holland, where more or less of it is produced as a by-product in the manufacture of peat stable litter and peat mull, by sorting out the fibrous parts of the peat after it has been shredded and as it is being conveyed from the shredding machine to the screens, or to the baling presses.

The work of sorting is done largely by women and children who stand by the sides of the conveyor troughs and pick out by hand the bunches of fiber as they go by. This crude material is then gathered up and either baled at once, or cleansed of chaff by beating and screening, if a better product is desired. The cleansed fiber has a number of uses in Europe, including the manufacture of coarse cloth, such as blankets for cattle and horses, for making mattresses, for hospitals and for children's beds, for stuffing furniture, etc. The finer grades of the cleansed fiber are said to be used for adulterating other fibers, even silk, in weaving cloth. Some is doubtless mixed with other fibrous materials and made into paper pulp, and it may be said in passing that the peat paper mill at Capac, Mich., was primarily located on its present site because of the large amount of fiber which the peat of the locality contained.

It is doubtful if there are in existence anywhere any peat deposits which contain nothing but fibrous peat of the kind here considered or in which the strong fiber constitutes any very considerable percentage of the whole mass. Some peat beds are made up of the remains of grass-like plants, and are fibrous, but the plant which furnishes the best fiber generally grows in scattered single clumps or stools, and not in masses covering large

areas, so that the fiber cannot be found in thick, broad layers.

The commercial fiber seems all to originate in the plants commonly known as "cotton grass," or, sometimes, "hare's tail," of which we have several species growing on our bogs in the United States. The cotton grasses are not true grasses, however, but belong among the sedges and bulrushes. The type under discussion gets its common name from the tufts of white hairs enveloping the seeds, which are borne in a head at the top of the stem.

The particular species from which the peat fiber coming to us from Europe is derived, is known scientifically as **Eriophorum vaginatum** L., the low or sheathed cotton grass. This species grows abundantly scattered over the dried parts of Sphagnum bogs in Europe, and in America is replaced by **Eriophorum callilrix** Cham., a similar species. Many of the Sphagnum bogs in the Northern United States are white with the cottony fruiting heads of these plants in the early part of summer. The plants form dense stools or bunches of narrow wiry grass-like leaves growing in the Sphagnum, and it is the bases of the leaves and the bladeless scales which grow among them around the lower part of the stems, that supply the fiber. When the plants die the dead leaf bases and sheathing scales are overgrown by mosses and eventually are imbedded and become part of the resulting peat.

Mr. J. G. Thanlow, Christiania, Norway, Peat Engineer for the Norwegian Government and Secretary of "Det Norske Myrselskap" (The Norwegian Peat Society), is planning to come to the United States to attend the meetings of the International Engineering Congress to be held ot San Francisco, Sept. 20-25. It is hoped that some arrangement may be made to have Engineer Thanlow give an address at the annual meeting of the American Peat Society, which will be held at Detroit, Mich., in September.

The Peat Fertilizer Industry, during the summer of 1914, had very favorable weather conditions, although the market conditions in the East and South were unfavorable on account of the European war and the financial depression attendant upon it.

Most of the peat gathered and dried, however, was sold, and at prices reported as satisfactory to the producers.

Peat Bed Hinders Engineering Operation. A large bed of peat uncovered at the northeast end of Silver Lake, Staten Island, New York, where the reservoir of the Catskill water supply system is now under construction, bids fair to increase the expense of the work and to lengthen the time before the water may be let into the basin.

When the work of draining Silver Lake, which is being enlarged to make the reservoir, started, John P. Hogan, supervising engineer of the Board of Water Supply, was unaware of the presence of the peat bed, and naturally had made no arrangements for its removal. It was only recently, when practically all of the water had been drained, that the deposit of vegetable decay, centuries old, was found.

The peat, which covers an area of approximately three acres, starts near the water mark at the northeast of the edge of the lake bed and runs down at an increasing thickness to a point near the bottom. When the work of draining started, last June, and the first of the peat was found, it was not thought that it was either widespread or thick. Not until draining ditches were cut through the mass itself was its extent realized, for in places it has been found to be seven feet deep. Mr. Hogan, who fears to leave the peat in place—not that it would be a danger to health, as peat water is known to be free from disease, but because it will eventually tear loose from the lake bed and float to the surface, choking the reservoir outlets, is studying the situation. This peat bed, according to Dr. Arthur Hollick, curator of the Staten Island Museum of Arts and Sciences, who has been asked by Mr. Hogan to aid in solving the problem of its removal, is one of the largest found in this section of the country.

Dr. Hollick is of the opinion that to burn the peat would be the cheapest way, although involving loss of time in construction.

H. P.

Nobody will go to Europe for a rest this year. There is no rest there, either for the righteous or the other kind.

Never trouble the waters in which you intend to fish.

Abstracts, Patents, Etc.

Dr. Herbert Philipp, Editor

Cranberry Culture. C. L. Lewis, of the Agricultural Experiment Station of Minnesota, in Bulletin 142 (July, 1914) writes on the "Selection and Preparation of Land for Cranberry Culture." He brings out as the salient features for this culture the necessity of a peat soil, which should be near a railroad. A source of water supply for use against frost, insects, drought and winter-killing, must be available. The use of sand prevents weed growth, promotes vine growth, raises the temperature of the bog, is an aid in protection from frost and improves the quality of the berries. The vines should be planted through the sand and at least one inch into the peat.

Besides the weeds and grasses, which must be kept out by hand pulling, the cranberry has two great enemies,—frost and insects,—but they can be controlled, to a great extent, by the proper use of water.

It costs $500 to $1,000 per acre to bring a cranberry bog to the bearing point and the bog should produce 50 to 100 barrels per acre, 75 being a good average.

The processes of clearing, ditching and planting are, comparatively speaking, the cheapest portions in the work of bog operation; the heaviest expenses are for grading, sanding, cost of vines and in the construction of dikes, dams and flumes.

Heating Peat to Hasten Drying. T. O. Franke, Br. Pat. 12,231 (1913). Peat, ooze, or wood pulp in a vessel is heated to render it more easily capable of drying by mechanical means, by steam which is passed through the vessel in alternating directions; the material may be agitated. As shown, a rotary vessel is used having sieves at the ends which are provided with tubular extensions connected to supply and exhaust pipes leading respectively to a valve and a condenser having a dirt separator. By the rotation of the vessel, a flow of steam is permitted alternately

through the pipes. The specification also states that hot gases may be used in place of steam.

Peat Digester. T. O. Franke, Br. Pat. 12,232 (1913). In apparatus for treating peat, ooze, and wood pulp with an alternating current of steam, as described in the patent specification, means are provided for stirring, cutting, mixing, pulverizing, and dividing the material. The vessel shown is supported by brackets and has sliding doors operated by screws turned from a hand-wheel; its rotary stirrer comprises oblique blades attached to arms following the curve of the vessel. The steam connections comprise a valved main pipe and branch pipes connected through valves and operated by a hand-wheel. The lower ends of the pipes are forked and lead to ports in the ends of the vessel, protected by sieves.

Expressing Liquids from Peat. T. O. Franke, Br. Pat. 12,233 (1913). In pressing wet peat, etc., to make it suitable for fuel, coke dross, or other fuel substance impregnated with oil, fat paraffin, resin, naphthalene, asphalt, etc., is added to the peat to render it non-absorbent. Iron filings, ironstone, sand, ashes, slag, coal, peat, mineral coke, lignite, charcoal, wood sawdust, chaff, straw, leather, manganese, salt, limestone, and stones are stated to have been added to materials, such as peat, from which moisture is to be expressed. The specification comprises also the application of the invention to expressing liquids in general. For example, in making cider, peat impregnated with fat is added to the apples to be squeezed, the residue serving as food for animals.

Preparing Peat for Drying. R. Von Traubenberg & J. Woldemar, Br. Pat. 15,715 (1913). Moist blocks which can be stacked at once for air-drying, consist of fibrous peat from the upper layers of a bog pressed to remove about half its water and then mixed with wet unpressed amorphous or bituminous peat, obtained directly from the lower layers. The blocks can be stacked in heaps of five, two upon three. Apparatus described includes two conveyors by which a moor is worked in two wide parallel steps. About equal parts of the two kinds of peat are mixed, or a greater proportion from the lower layers, if the upper layers are very fibrous.

Marsh Soils in Wisconsin. Bul. 205, Wis. Agr. Exp. Sta., July, 1914. Messrs. Whitson, Weir and Ullsperger have edited a bulletin treating with the improvement of marsh soils.

Wisconsin marsh lands comprise 2,500,000 to 3,000,000 acres, some of which lies in large marshes of from 25,000 to 50,000 acres, but a large part is in small tracts. Through proper drainage and soil management much of this land could be made very productive and would add greatly to the farm area of the state.

The chemical composition and the possibility of thorough drainage are the chief factors which determine the value of marsh lands for cultivation.

The drainage of marshes is the first step toward improvement. On large marshes the organization of drainage districts and the co-operation of a number of adjoining land owners is necessary, but thousands of farms include some marsh land which can be readily drained by the owners without legal difficulties.

Proper tillage of marsh lands is of the utmost importance. Heavy rolling, by packing the loose peat soil, produces a firmer seed bed which is better adapted to cultivated crops, especially small grains.

Fertilization of marsh soils is important on account of the unbalanced condition of the elements which they contain. Marsh soils are excessively rich in nitrogen, but are frequently deficient in phosphorus and potassium. While barnyard manure will supply the last two elements, these can be supplied in commercial fertilizers, allowing the use of barnyard manure on upland soils where its nitrogen and organic matter, as well as its mineral elements are needed. Under such special conditions it is profitable to use commercial fertilizers supplementing the manure of the farm.

Acidity develops in marsh soils quite commonly where lime carbonate is not brought in from surrounding higher land. This acidity, however, does not interfere with the growth of crops provided the soil is properly fertilized. Very commonly acid soils require phosphate as well as potash fertilizers. The acidity of marsh soils in the southeastern part of the state is very generally neutralized by the lime carbonate in the water seeping in from the surrounding higher lands of this limestone section.

The crops best adapted to marsh lands include corn, potatoes,

cabbage, buckwheat, and timothy and alsike clover for hay. When the soil is thoroughly firmed by rolling, small grains can be grown, of which wheat and barley are best, with oats and rye second. With proper care excellent tame grass pastures can be developed on these marshes.

Norwegian Peat Industry in 1913. (Consular Report.) Favorable weather and high prices for coal together resulted in an increase in the amount of peat produced and used in Norway during the year. Of the 11 peat factories in Norway two were not operated because of scarcity of help. Some of the largest dairies are using peat fuel with much satisfaction, partly because of the expense of transporting coal from tidewater. This industry is hampered because of poor machinery, the claim being made that no machinery yet tried has proved satisfactory in use.

Muck Lands in Michigan. Bul. 273 Mich. Agr. Exp. Sta., June, 1914. Dr. C. S. Robinson has carefully studied the utilization of muck lands in Michigan and has come to the following conclusion:

The swamp lands of Michigan represent a neglected source of wealth to the farmers of the state. A large proportion of them could be developed in a practical way and used for the financial enrichment of their owners.

Many areas of marsh could be used for the permanent production of crops by draining and application of the proper fertilizer. Potash and phosphoric acid are the mineral fertilizing elements which give the best returns, while barnyard manure also causes a large crop increase in most cases. Except on distinctly acid deposits, lime does not as a rule give good results.

Deposits which are not suited to the direct production of crops may be used to reinforce manure either in composting or as a stable litter. In this way the manurial value of the muck is increased while the valuable ingredients of the mixture may be materially enhanced by the addition of phosphatic material.

Assimilability of Nitrogen in Peat. P. Hoe (L'Engrais 1913, Vol. 28, p. 799.)

The author recommends the use of peat as a fertilizer to

those agriculturalists who have farms near peat deposits, even if the nitrogen contained in the peat is not as active as saltpeter. The durability of the peat, together with the small quantities of mineral matter contained in it, makes it an inexpensive and valuable aid to the farmer.

Dewatering Peat. A plan by which the wet peat is transmitted through rolls on a permeable transmission band. Torfwerk-Schluelp-Nortorf, Holstein — German Pat. 276,763 — Feb. 26, 1913.

The transmission band consists of a rough fabric like woven cocoanut fiber, such, for instance, as is used for foot mats. The brush-like hairs, which stand up about 1 inch on the cocoanut-fiber belt, upon which the peat is placed, roll down flat while passing through the rolls, but take their original position again after leaving the rolls. The peat remains loose on the transmission band without having passed into the interstices. The yielding and elasticity of the belt allows large pieces of peat to pass under the rolls without any difficulty.

Light Waterproof, Sound Proof and Fireproof Building Material from Peat. H. Schlisske (German Pat. 276,973—1913.)

The dry crust formed around peat blocks which have been exposed to the atmosphere is removed previous to artificial drying; by this means a complete drying, even to the center of the block, can be accomplished. The blocks harden and become stronger as they lose moisture. Large blocks, after taking off the crust of air-dried peat, have cylindrical holes bored in them in order to accelerate the drying of the center of the block. After completing the drying the surface of the block is impregnated by the application of vacuum or pressure. The blocks are claimed to withstand knocks, etc. As impregnating materials are mentioned: Tar, asphalt, stearine, pitch with or without loam, clay, etc.; also insoluble silicates are recommended.

Peat Gasification. For the generation of power and heat, the generation of gas from peat fuel has many advantages over using the peat on a grate. In the gasification, peat with larger moisture content can be used than on a grate. The so-called by-products

can be recovered, especially the combined nitrogen, which is lost by burning the peat on a grate, may be fixed in the form of ammonia compounds in the gas producer. By passing in superheated air and steam (400-450° C.) into the glowing peat in the producer, fuel gas and ammonia are obtained, the ash falling into the water in the pit. (Frankfurter Zeitung, July 6, 1914.)

Italian Plant for Converting Peat Into Electricity. The question has been asked by an American gas company whether there is in operation at Pontedera a plant for the utilization of peat in the manufacture of electric current, with special provision for particular recovery of ammonia in the form of sulphate as a by-product; that if this plant is now in operation, when it was built, and its approximate capacity.

There is in operation at Orentano, about 8 miles distant from Pontedera, such a plant. It was built 6 years ago. Its approximate capacity is the development of 2,000 kilowatts.

In the combustion of the peat used here ammonia in the form of sulphate is gained as a by-product. The plant is of the English system known as the "Mond." The peat used is dug from the bottom of a former lake, once known as the Lake of Bientina.

Improvements and additions are now being made to this plant for the primary object of developing a stronger electric current. It is owned and operated by Società per l'Utilisazzione dei Combustibili Italiani, and its principal office is in the city of Milan, Italy. When so enlarged electric current will be supplied to the Società Ligure Toscana di Elettricità to propel street cars and for other industrial purposes. (Consul Frank Deedmeyer, Leghorn, Italy, in Daily Consular and Trade Reports.)

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The Codigoro, Italy, Gas-Producer Plant Using Peat Fuel With Ammonia Recovery*

By Wilfred Beswick, of Stockton-on-Tees, England

In presenting to you this paper at the request of your esteemed Editor, Professor Davis, I propose to confine myself to a general description of one of the latest Mond peat-gas recovery plants, of my company, The Power-Gas Corporation Ltd., of Stockton-on-Tees, England, with a view to describing the simultaneous production and utilization of peat fuel for producing gas for power or heating. In the particular installation described, the nitrogen content of the peat is high enough to warrant the continuous operation of the plant for the recovery of ammonia as the principal product. There is practically no outside use for the gas. I shall also show that in this instance it is possible to operate the plant all the year round without the aid of air or sun drying on the bog and without stocking peat; in other words the peat is taken directly from the bog into an artificial drying plant and fed into the producers, the whole operation occupying only a few hours.

There is one condition in this installation especially favorable to continuous work, namely, the peat in the bog has a comparatively low average moisture content. We have, however, proved by long trials at other installations where the peat in the bog is of a high moisture content—about 90 per cent—that after preliminary drying to about 70 per cent, the same continuous operation can be maintained. For this preliminary drying a cheap and efficient continuous process is being worked out. In this connection a simple form of press that could be applied to different qualities of peat would be of great importance, and we shall await with interest the communications you are expecting to receive on this subject.

The plant discussed in this paper was supplied by us to The Societa per l'Utilizzazione dei Combustibili Italiani of Milan, for

*Read before the eighth annual meeting of the American Peat Society at Duluth, Minn., in 1914.

installation at Codigoro in the province of Ferrari, Italy, and it is by the kind permission of that company that I am able to give you the particulars herein contained.

The Codigoro plant is the second that we have supplied to the same company, the first having been put down at Orentano in the province of Florence. The Orentano installation has a capacity of 90 tons of anhydrous peat gasified per day; the Codigoro installation has nearly double this capacity. At Orentano the gas is delivered to an electric central station, where it drives five 500-brake horsepower double-acting gas engines driving alternators in parallel. The electric current is distributed over the surrounding district into the town of Pontedera 14 miles away from the plant. The Orentano plant has been entirely successful technically and mechanically, and has now been in operation about 4 years. There have, however, been some difficulties in regard to the supply of peat, which have affected the economic

General View of Plant, Showing the Producers.

aspect of the plant. Further peat areas have now been procured, and a better drainage system has been established, thereby insuring a continuous supply of peat on a larger scale than has hitherto been possible. It is expected that the gradual increase of the electric station will enable the plant to operate on a much better average load and procure substantial increase in the profits of the undertaking.

It is, however, a source of satisfaction to know that at present the plant is more than paying its way in spite of its handi-

caps, and that a yield of about 115 pounds of sulphate of ammonia per long ton of anhydrous peat containing about 1.5 per cent of nitrogen is being obtained. This nitrogen content is relatively low, and is not sufficient to enable the plant at Orentano to operate continuously at full load without regard to the utilization of the gas. It will be readily understood that with the greatly increased yield of sulphate obtained at Codigoro—about 50 per cent more than the yield at Orentano—and with a much bigger gasification of peat in relation to the labor employed, the profits of the plant are materially increased.

I will now proceed to give you a general description of the property at Codigoro, and will then describe the lay-out of the peat bog, the peat-drying station, the gas plant, and the sulphate-recovery plant.

In the vicinity of Codigoro not far from the estuary of the river, where the level of the country is 1 to 2 meters beneath the level of the sea, large peat regions have been turned into districts, allowing advantageous industrial developments by means of progressive draining carried out in the form of a net-work of canals conveying water to the great pumping station at Codigoro. Amongst these regions the best one, of an area of some 4,000 acres, sufficiently concentrated on the east and west of the town of Mezzogoro, today presents special characteristics which distinguish it for the universally known peat beds. The peat in this vicinity contains a large quantity of nitrogen, and is excellent for cultivation. The peat layer is not very thick, and is fibrous at the bottom and pulverulent on the surface. The average percentage of moisture in this peat layer between the fibrous part and the pulverulent part does not attain the figure of 60. Industrial treatment is thus facilitated, and excavation, transportation, and drying are easy and economical.

During the course of more than 20 years, numerous concerns have endeavored to work this peat bed, though without success, each failure being due either to the customary difficulties attendant on drying, or to the fact that each development company has had in view the preparation and the sale of the peat to serve as a fuel.

A few years ago the Codigoro company, now in liquidation, bethought itself of a method of treatment which is well known in America, though almost altogether unknown in Italy, namely, the using of dry peat dust as a fertilizer, and to this end erected a factory for the manufacture of humus and compressed-peat briquets. The small demand for this product did not cover the heavy expense entailed in supplying and working the plant, and the undertaking was not, therefore, successful.

The S. U. C. I., after a long study of the conditions, erected

towards the middle of the year 1913 the present Codigoro works, and carried out a plan that, in addition to being unique, is one of the most important installations for the utilization of peat at present existing in the world.

We must point out here, briefly, for the better understanding of what will be said further on, the program of the company, a program that is based on rational ideas, which have already received practical application in the Orentano plant already referred to.

Poor fuels, and particularly all kinds of peat, bear either badly, or not at all, the expense of transportation, and even after being sold at relatively low rates are unable to compete with coal, owing to the peculiar contrast in their nature.

The mistake everybody has so far committed, and one that has been the cause of numerous industrial failures, is not taking into account the other characteristics of such fuels, and of failing to consider all the possible advantages.

All fuels contain more or less nitrogen, originating in fossilized trees and plants, that is to say, nitrogen in ammoniacal form, or stable and recoverable as ammonia. Such nitrogen is found in large quantities in many peats and lignites, and frequently its value largely exceeds that of the carbon. In addition the peat and lignites also yield tar, and several of them yield sulphur and iodine, whilst the ashes are rich in potash, soda, and other substances, and are capable of constituting the first element of good binding material for construction work, and for efficient corrective substances for agricultural land.

These products and by-products have a value far from negligible, though such value has hitherto been neglected. The quality of such products is completely dissipated when the fuel is consumed in furnaces, as has hitherto been the method of using it for the purpose of heat generation.

It is obvious that if an industry is to profit by whatever is utilizable in the so-called poor fuels, such fuels must be treated so that fuel value will be realized. It is, therefore, necessary to contemplate the erection of large industrial establishments in the peat bed or mine centers, as well as a method of treatment that insures nothing being lost. This object can be attained only by gasification, which can be carried out either by the dry or the wet process.

The dry process enables coke and tar and a small quantity of gas to be obtained, and in the water used for washing the gas there is ammonia, though only in limited quantities, owing to the greater part of the ammonia being destroyed by the high temperatures attained in the retorts. This does not constitute the real solution of the problem, and may, therefore, be economically

adopted only when the peat to be treated contains a low percentage of ash, is poor in nitrogen, and when there is a possibility of selling in the vicinity the peat coke, which is best used in the metallurgical industry for certain special treatments of steel. The gas produced by the dry process is used for heating the retorts. We are informed that the few establishments existing at present have great difficulty in getting along.

The wet process, on the other hand, enables the whole of the gas to be obtained and subsequently sold and utilized by third parties, with the exception of the quantity required for the establishment's own consumption. In addition, this process enables the nitrogen content of the peat to be extracted in the form of ammonia, which can be immediately fixed and converted into sulphate of ammonia, which at present is the best chemical manure known, so much so, in fact, that in the course of a few years the world's consumption of this substance has increased ten-fold. Good tar is likewise obtained, which can be distilled and refined, and yields paraffin and more or less heavy oils; other by-products may subsequently also be extracted

If the fuel used contains a certain quantity of nitrogen, the consequence of the adoption of this process may be that the gas obtained will cost nothing at all, as the by-products will cover all the expenses. Anyone can see at a glance the importance of this fact in a country such as Italy, which is poor in good coal and rich in bad fuels. As the gas costs nothing, plants of this kind are on a level with hydroelectric plants, with the added advantage that the production of sulphate of ammonia may render unnecessary the paying of heavy freight and duty on this product from abroad and may aid in extending the use of this substance to the great advantage of local agriculture.

Dr. Ludwig Mond was the first to conceive the idea of adopting the wet gasifying method for the purpose of utilizing coal débris, and waste coal that it is not expedient to export, by erecting suitable plants in the vicinity of the mines. The extension of this idea and the application of the method to peats and lignites was suggested and investigated by Dr. Mond himself, and is now successful. The first plant of the kind erected was at Orentano. This plant was amplified by the addition of a plant for the preparation and artificial drying of the peat, which represents the solution of the real weak point of every installation of this kind.

Finally, there has been evolved the plant at Codigoro which represents a remarkabe affirmation of further study and experience on the part of the seller and the user. and in which all the difficulties referred to above have been successfully overcome.

As a matter of fact, the only two important plants in the world at present working peat on a big scale all the year round,

on rational lines, are the Italian ones, and they belong to a company that has overcome many obstacles, and must be given the credit for having completely carried out its program and thus pointed out to the world the way to put to good use natural riches that have hitherto lain unknown and neglected.

At present, in view of all results obtained, it would be a gross economic mistake to neglect the cultivation of peat beds or lignite deposits or to use such fuel direct in boiler furnaces for the purpose of producing motive power in large plants, as except in rare instances, the result of such a practice would be to sacrifice a great part of the possible profits and to incur much heavier running costs. In England and in Germany no important coal-gasifying plants for power uses are being constructed without due consideration being first given to the recovery of by-products, and now that the peat problem may be said to have been solved, the attention of all the world's specialists is being directed to the method of utilizing this material, as is proved by the interest shown by them in the work carried out by the Mond plants in Italy.

The peat beds of Codigoro are two in number, one of an area of 1,750 acres, which once belonged to La Codigoro Company, in the vicinity of the establishment, and the other of an area of about 1,250 acres, known as the Monticelli, at some distance from it. In the vicinity there are some other peat deposits, some of which may perhaps be profitably worked.

These peat deposits have been carefully investigated. A careful sounding chart has been drawn up, and the regulation and leveling of the underlying ground, when the whole of the peat shall have been extracted, has already been completely provided for, drains having been likewise projected in order to render such land more profitably workable. The crops cultivated are melons, corn and grapes.

The quantity of peat available in the two large deposits is sufficient to insure the supply of material to the producers for a period of over 25 years.

The average thickness of the peat is 18 to 24 inches, but as the bed on which the peat rests is of an undulating character, there are points at which the deposit reaches a thickness of 3 feet. The peat lies on the surface and can be easily excavated. The peat is free from trees or other obstacles and is of a fibrous character, though the draining of the peat bed carried out by the previous concern has resulted in the surface part of the peat being largely reduced to powder under the action of cultivation and the yearly ploughing operations.

The average amount of moisture contained in the peat is 58 per cent, and the specific gravity is about 0.70; that is to say, 1

cubic meter of peat in a damp state immediately after excavation weighs about 700 kilograms, and contains about 300 kilograms of anhydrous peat. For practical purposes we may calculate that 3 to 3.5 cubic meters must be excavated in order to obtain 1 ton of anhydrous peat.

Excavation work is carried out by hand and the workman loads direct on the wagons provided for conveyance. The wagons are designed and constructed to allow easy loading and unloading and are of a capacity calculated to insure every workman continuously having one wagon ready for loading.

The field of excavation is encircled by tracks which the trains can reach easily and leave without loss of time, and one train is always in course of loading. The length as well as the widths of the field of excavation are calculated on the basis of the measurements previously carried out, and from day to day one squad of workmen lays the track intended to serve for the following day, removing the one adjacent to the field already excavated.

The railway line connecting the field of excavation with the plant proper has a double track. It is well laid, and is equipped with numerous switches.

At present its length is about 3 kilometers, but altogether there is 10 kilometers of track, including that on manuring areas and fields of excavation, and the line proper.

The rails are light, weighing about 7 kilograms per running meter, and are laid on wooden sleepers placed 70 cm. apart; the sections of movable track on the excavation fields are laid on wide planks which form a continuous supporting structure extending over the soft ground

The line traverses the Bella canal on a single-track ferro-concrete bridge, and the Vipera trench on a double-track wooden bridge. It runs throughout on the level with the exception of the two gradients at the Bella bridge, which are rather steep. An important detail of the problem was that of operating over so light a track, which is nevertheless suited to the peaty nature of the bed, steam locomotives capable of pulling trains of 10 to 12 cars each on a maximum gradient of 5 degrees. This detail of the problem was solved by adopting light locomotives with four coupled axles. The locomotives, under operating conditions, weigh 6 tons. They are designed on rational lines. They can turn on curves of less than 10 meters radius, and consequently the end axles carrying the wheels are of the tubular concentric type, each being connected by cardan joints to the center of a solid inner axle. Each inner axle is connected by rods and cranks to the locomotive.

It has thus been possible to obtain a relatively powerful locomotive of high traction power without putting on the rails a load of more than 1,500 kilograms per axle.

The trucks have a capacity of about 2.5 cubic meters each, so that a train of 10 to 12 trucks can carry on each journey 6 to 7 tons of anhydrous peat, or 14 to 18 tons of wet peat. As a general rule there are two or three locomotives working and pulling in turn a series of seven trains. The fourth locomotive is held in reserve.

The whole of the plant has been designed with the greatest care and has perfectly answered the requirements of the service that must obtain a total of 150 tons of anhydrous peat per working day, plus a reserve of one-third, as it has been calculated that excavations cannot be carried on for more than 240 days a year, allowing for 125 days as holidays, wet days, or days during which the peat is frozen. Thus an average of 700 to 800 cubic meters a day must be excavated and transported, or about 400 trucks must be loaded.

The railway plant can, however, deal with more than 1,000 cubic meters per day, allowing for the longer journeys that will have to be made in the course of a few years.

In addition to the hand method of excavation the company has at its disposal an excavating machine that has been designed expressly for this plant by Dr. W. Wielandt, a noted expert of Oldenburg, Germany. This machine is automatic in its movements of advance and of return to the original position ready for a fresh excavation operation. It has, at the bottom, a cage type of drum, which rotates at a high speed, and a series of small knives placed at various degrees of inclination. Some of these knives cut into the peat to a depth of a few centimeters and the others remove it.

A wide gripping device picks up the peat thus cut and raises it to a projecting conveyor which discharges it direct into a truck standing by the side of the excavator. The machine can by itself excavate more than 600 cubic meters in 10 working hours.

It is driven by electricity. It is capable of excavating at a single effort deposits of a depth of 50 centimeters, and what is more, the lowering of the excavating device is automatic. This machine can do the work of 30 men. To complete the peat-bed installations electric wires carrying a high-tension (2,500-volt) current run along all the main roadways. Movable cabins mounted on bogeys can be quickly established at any point. As the canals cut into the whole extent of the peat bed, the deposits can be kept more or less dry, and special electric centrifugal pumps facilitate drainage regulation.

Finally, there is everywhere provision for telephonic communication with the plant. The success of installations of this kind is based on perfect organization of all the slightest details of the equipment. Above every other requirement there must

be the means of supplying without difficulty the material needed day by day. In this regard the organization of the Codigoro peat plant is a perfect success, as it has been carefully thought out with a thorough knowledge of all the difficulties and requirements for this kind of work.

Contrary to the system generally adopted, the Codigoro plant does not dry the peat in the sun, but artificially, and during every hour of the day the whole year long.

The plant for the preparation and drying of the peat occupies the whole of the western side of the establishment, running along the Bella Canal.

Showing the Range of Mechanical Driers.

From the bridge over the Bella Canal, the railway track turns at right angles with a curve of 15 meters radius on the down gradient, and from this track, running parallel to the canal, there branch off numerous other tracks. Three large adjacent sheds, each equipped with tracks inside and out, have been erected to facilitate the arrival, unloading, and departure of the trains.

These sheds each contains a peat conveyor which is horizontal for a distance of 35 meters and then inclined. On the two sides there are two inclined planes which serve to hold the peat unloaded from the tracks and to carry it to the conveyor.

The conveyor discharges the peat into a mixing machine, which is formed of two screws rotating in opposite directions, and operated by an electric motor. The mixture of fibrous and pulverulent peat issues from the mouth of the machine and falls into a second similar machine mounted in series with the preceding one, where it becomes more compact and more intimately mixed. The mouth of this second machine has been designed in

such a way that the peat issues from it in small pieces which fall on iron frames equipped with metal gauze which are subsequently loaded on special trucks. Each truck contains 42 frames, on which are loaded about 2 tons or more of peat containing on the average 58 per cent of moisture, or about 800 to 1,000 kilograms of anhydrous peat.

Special precautions have been taken to insure the continuity of the work. A system of water pipes provides a means of adding water if the peat becomes very dry. The speed of rotation of the knives has been made proportionate to the amount of moisture desired.

It is calculated that in every shed 50 tons (about 150 to 180 cubic meters) of wet peat is treated per working day of 20 hours, but in practice it is possible to attain an output of 80 trucks, that is, 65 to 70 tons of anhydrous peat, so that the three preparation plants could insure an output of more than 200 tons of anhydrous peat a day. There must always be a reserve available, as the trains arrive only during the hours of daylight, whereas the work of preparation goes on throughout the full day of 24 hours; hence the inclined storage bins are built large enough to contain more than a sufficient supply of peat to insure the continuity of the service, and other depots are being arranged in the remainder of the area.

The loaded trucks are drawn mechanically onto a conveyor truck which runs along a track parallel to the large drying building. This track is of the heavy electric traction type with an electric capstan for pulling the trucks, and serves to convey the latter to the entrance to the drying chambers.

The drying building covers an area of over 2,000 square meters and is divided into 12 galleries or chambers where the trucks remain for a certain number of hours.

At the other end there is a large shed some 60 meters in length, in which the trucks are unloaded, an operation that is effected by means of a track of identically the same dimensions as the one mentioned above. The frames carrying the dry peat are unloaded on a double inclined plane, along the center of which runs an iron-box conveyor which for a length of 16 meters is horizontal and for 36 meters is inclined, and serves for raising the peat to the producers.

The operation of drying is effected by means of the products of the combustion of gas or tar in the boilers auxiliary to the gas plant and by means of special furnaces in which gas is directly burned for producing the heat required. The hot gases are drawn in by 13 fans, 11 of which are of a large type and two of the small type. A well-planned arrangement of intercommunicating underground galleries insures a thorough mixture of the hot gases and the outer atmospheric air, so that the temperature of

the gas drawn in by the fans and driven amongst the galleries does not exceed the desired limits.

A suitable number of gratings conveniently arranged along the walls of the drying chambers insures the trucks being acted on by the hot gases.

The quantity of heat required for the drying operation depends on a countless number of small factors of design and operation of the driers; and the number of trucks that can be accommodated inside the galleries, their position with respect to the hot-air inlets, the temperature of the hot air admitted, the speed and temperature of the moist air flowing out, etc., depend on the conditions of temperature and moisture of the surrounding air.

The driers at Codigoro are arranged to evaporate up to 200 tons of water a day, and the fans are capable of distributing through the galleries as much as 100 cubic meters of hot air a second.

This plant, which is perhaps the most important hitherto constructed, was designed on the basis of the results and experiences obtained at Orentano (patent of S. U. C. I. and the engineer, D. Civita).

If air drying had been substituted for the Codigoro process, to obtain a yearly production of 50,000 tons of anhydrous peat, involving the handling of approximately 170,000 to 180,000 cubic meters of peat excavated by working 75 days a year during the favorable season, about 30 fields with as many mixing machines and about 1,200 workmen would have been required.

Apart from the heavy cost of such an air-drying plant and the high price of the peat, due to the numerous operations that such a method of treatment entails (spreading out, turning over, forming small heaps, reloading, conveying to the store houses, forming heaps for storing purposes, reloading, and conveying to the plant), it would have been impossible to obtain during the short summer season the labor required, as in this season workmen can find more remunerative employment in the open fields. It may, therefore, be asserted that the drying plant alone has rendered the industry at Codigoro possible of realization. Without this plant the project could not have attained its present proportions and would never have paid.

True it is that part of the gas produced is consumed for drying purposes, but in view of the fact that the high percentage of nitrogen contained in the Codigoro peat makes it possible to consider the gas as a by-product, which costs nothing at all, the cost of practical use of any such gas would be much lower than the cost of the labor that would be required for the production of sun-dried peat.

The fact is that the cost of peat dried and conveyed to the producers does not exceed 3 lire or francs or 60 cents per ton

of anhydrous peat, including excavation, transportation, preparation, and drying.

The plant for gasifying and producing sulphate of ammonia consists of the producers, the recuperating and washing towers, the circulation tanks and the plant for the vacuum concentration and crystallization of sulphate of ammonia.

To grasp thoroughly the importance of this branch it is neccessary to preface our description by a few remarks respecting the principle on which it rests.

To obtain Mond gas, that is, a gas of special composition which enables the maximum recovery of ammonia to be realized, the gasification must be effected in a special type of gas producer and with the observation of special precautions. The mass of peat in the gas producer is partly ignited and traversed by a current of hot air saturated with water vapor. The dissociation of the water vapor in the presence of the incandescent mass of fuel produces a gas which contains about 10 per cent. of carbonic oxide, slightly less than 20 per cent. of carbonic acid, from 25 to 26 per cent. of hydrogen and 4 to 5 per cent. of methane, that is, about 40 per cent. of combustible gases. The composition of the gas varies with the temperature of the air-and-steam mixture. and the combustion zone must be kept in a precise position in the producer, or the composition of the gas will be changed, and there will be a risk of diminishing the production of ammonia.

The gas thus produced is first washed in a vessel equipped with a mechanical spraying device. The dust and soot and the first part of the tar is deposited here. The gas then passes into another vessel, following a sinuous course in order to leave the water in suspension. Next it traverses in an upward direction a lead tower (ammonia absorber) with a wooden base, which is filled inside with rings, and in which it encounters in its passage a fine shower of sulphuric acid or diluted solution of sulphate of ammonia, which absorbs the ammonia content and transforms it into sulphate of ammonia.

The gas leaves this tower without the slightest trace of ammonia and proceeds downward again in order to rise inside a second tower (gas cooler "A") analagous to the first one, though of iron, in which it encounters a shower of cold water which becomes heated in washing the gas. The gas, having imparted part of its heat to this water, descends again, and rises inside the third tower (gas cooler "B"), of identically the same type as the preceding one, in which it again encounters another shower of water. The cooling process is now completed.

Thus purified and cooled, the gas is conveyed to the boiler and drier burners and might be used (after further washing and drying treatment) for operating gas engines.

The acid solution that has traversed the lead tower falls into a lead tank in which it deposits the dissolved tar, and is subsequently pumped by means of a lead centrifugal pump up to the top of the tower in order to continue circulating in such a way that the degree of saturation increases gradually. From time to time this tank is emptied into another similar tank, from which the solution saturated with ammonia proceeds to a concentration apparatus, fresh sulphuric acid being added continuously to the first circulation tank for the purpose of combining with the ammonia of fresh volumes of gas. The water circulated in the iron tower falls into a tank in which it leaves also some of its tar and is then pumped into a fourth tower in which it encounters during its passage a column of air impelled by a high-pressure centrifugal blower.

This air by becoming heated cools the water, which then returns to circulate in the second tower (gas cooler "A"), thus establishing a closed cycle and serving as a vehicle for the heat that, taken from the gas, goes to heat the air. This heated and moistened air is then (after being supplemented by steam from other sources) superheated, and it is this air and steam which, when conveyed into the inside of the producer, serves to generate the gas. The water of the third tower (gas cooler "B") may be discarded after having deposited its tar, but this third tower may likewise be put in cycle with the second and fourth towers, thus establishing a continuous circulation by means of the tanks and the pumps, whereby the water is heated by passing successively from the second and third towers, and is cooled by circulating in the fourth tower.

At Codigoro there are six producers of a type that have proved to be the best adapted for the gasification of peats and lignites. These six producers are fed by a peat distributor mounted overhead, to which the peat is carried by the box conveyor mentioned above.

The loading of the peat is effected by means of a double elevator. The gas passes into the main collector, which is designed to take 12,000 cubic meters an hour, and by this collector it is conveyed to the mechanical washer and thence to the towers, which are 18 meters in height.

At the end of the third tower there is a small bell which closes the main pipe and serves as a regulator, operating by means of a suitable gearing the air-outlet valve of the centrifugal blower.

At the outlet from the third tower and before the bell aforesaid is reached, there branch off two gas pipes which are led underground. One of these pipes goes to feed the dryer burners whilst the other goes to the boilers. There are quick-action hydraulic stop valves for intercepting the passage of the gas

The large gas collector is provided inside with a continuous-action cleaning apparatus, the object of which is to prevent deposits of dust or tar. A series of outlets equipped with automatic valves allows a quick emptying and discharge of the condensation water, which is rich in ammonia, and is subsequently led into the acid circulation tank.

The blower which serves for pumping the air in the fourth tower (air tower) is worked by an electric motor, and all the other motors comprised in the plant are likewise of the electric type. In the event of unforeseen stoppage, there is an automatic injector fitted on the air-supply tower to prevent the return of the air in the piping, which might result in explosions.

A measuring apparatus of the graphical recording type shows at every moment the quantity of air that is being fed into the producers. Thus, the amount of gas circulating in the injectors is easily determinable.

The extraction of the ashes is of considerable importance, as the peat contains 20 to 30 per cent., or even as much as 35 per cent., so that approximately 35 to 50 tons per day has to be taken from the bottom of the producers, where the ashes fall into the pits or lutes containing the water for extinguishing the coals and form the hydraulic sealing of the producer itself. The extracting of the ashes is at present effected by hand, but a method of doing the work mechanically is being worked out.

The most important part of the plant, and the one that has necessitated the deepest study, is connected with the foundations. In view of the yielding, muddy nature of the ground, which is composed of peat mixed with clay, the load could not be greater than 200 grams per square centimeter. Recourse had therefore to be had to cement foundations large enough to keep the load within the desired limits. Thus it is that the foundations of the towers have a diameter of 14 meters, a fact that explains the considerable distance between them.

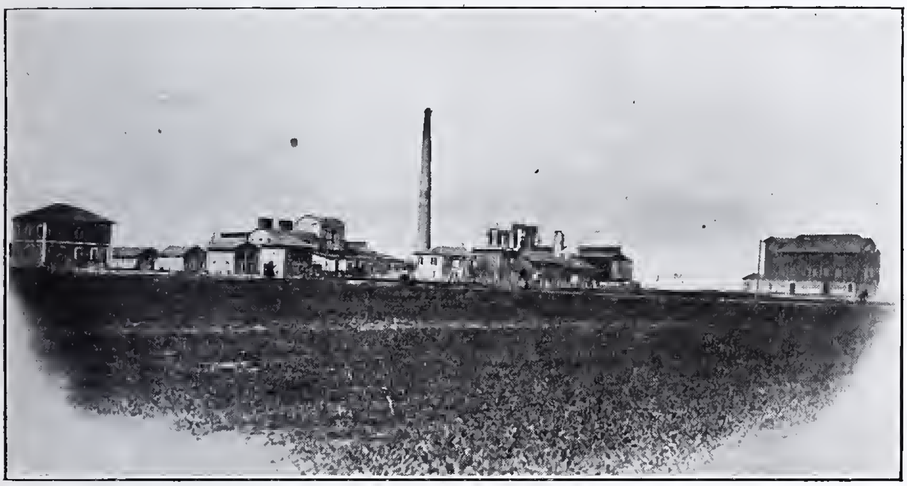
The producers are provided with independent foundation blocks and the whole complex system of gas, air, and steam piping has been designed in such a way as to allow successive adjustment, in the event of movements. However, as yet no adjustment has been necessary, owing to the precautions taken.

All the pumps are mounted beside the towers and the tanks, and are coupled direct to electric motors, so that in the whole of the plant there are scarcely any transmission belts to be found. The quantity of piping required is thus reduced to a minimum, and there is no encumbrance of any kind whatever in the arrangement of the plant; the pipes themselves are conveyed through large underground channels covered with easily removable plates, and can thus be easily inspected.

The producers are capable of gasifying 30 tons of peat each per 24 hours, if the moisture contained in the peat introduced into the producers does not exceed 30 to 35 per cent. With an output of 150 tons, 270,000 cubic meters of gas of about 140,000 calories can be produced per day. With the average percentage of nitrogen stated—2.3 to 2.4 per cent,—practically 80 kilograms of sulphate of ammonia can be obtained for every ton of peat, that is, about 120 quintals a day with an acid consumption of about 150 quintals a day at 56° B. A quintal is equal to 100 kilos or 220.46 pounds.

The plant for the concentration of sulphate consists of two vacuum evaporation apparatus, a vacuum pump with surface condenser pumps for the raising of the solution, and a centrifugal extractor for the drying of the crystallized sulphate.

The solution of sulphate of ammonia of the right density is contained in a large tank at the foot of the building. The solu-



General View of Plant, Showing Acid Plant to Right.

tion is raised by means of a special centrifugal pump, and is conveyed into the concentrator where a good vacuum is produced. In this concentrator, and on the outside of its tubular nest, there circulates steam proceeding from the exhaust of the steam turbine of the electric power station; the water evaporated from the solution is drawn in by the condenser. When the solution has been concentrated, it is withdrawn from the body of the evaporator and centrifugalized, and the sulphate of ammonia in crystal form falls into the trucks, which carry it to the store house.

At every operation two quintals, or 440.92 pounds, of sulphate is dried with the centrifugal.

Attached to the producer plant there is a chemical laboratory in which are continuously being carried out the analyses re-

quired for checking the working of the whole plant. In this laboratory are mounted all the pressure gages, which show the pressure along the gas piping and at the inlets and outlets of the various towers.

The sulphuric acid factory is a building standing somewhat separate from the remainder of the establishment, to which it is connected by means of underground lead piping for conveying the acid to the sulphate solution circulating tank.

It is made of wood, with inclosing masonry on the ground floor, and rests on a large foundation of hard cement.

In an anteroom there are erected the Herreshoff furnaces, together with the dust chamber. Another room houses the auxiliary machinery and an oil motor, which serves to insure the working of the factory during the ordinary short stoppages necessitated by the proper upkeep of the electric power station and the plant as a whole, and yet another room contains the lead blower for regulating the draft. In the large shed there are the Glover and Gay Luccas towers and the three lead chambers, of a capacity of 2,000 cubic meters. Platinum sprayers are also available for working with purified water, when it is not desired or not possible to use steam. A Kastner acid raiser and a plant for utilizing nitrate of soda or nitric acid complete the plant, which is capable of yielding 150 quintals, or 3,300 pounds, of acid a day, when worked under normal conditions.

There are, moreover, ample stores for pyrites and large tanks for water, together with trucks for the conveyance of pyrites and the removal of ashes, as well as the most complete and up-to-date appliances that can be desired in a plant of this kind.

Timber has been largely used in the construction, in order not to increase the load on the foundations and to render more easy the execution of such repairs as the movement of the ground may necessitate, though seemingly there has not as yet been any occasion for such repairs.

The acid from the tanks can be led into a marked tank in connection with the circular tank of the ammonium sulphate solution, an arrangement that makes it possible to take the quantity required for the daily needs of the establishment.

The electric power station supplies the energy required for all the services of the establishment. It is erected in a spacious building which forms a continuation of the one for the concentration of sulphate, and is divided into two parts. In the first part are housed the boilers and in the second the turbo-alternators.

The characteristic feature of the boilers is that they are not equipped with grates, being intended for heating with gas, or, occasionally, with tar. Thus it is that on the front of each of

these boilers we find three gas burners and three burners for burning tar. The gas burners are large Bunsen burners in which it is possible to regulate a flow of the air in two ways, as in the case of Bunsen burners for laboratory purposes. The tar-burners are of the steam-injection type. The tar is contained in an overhead tank, in which it is kept in a liquid state by means of a steam coil, and from which it descends through a pipe along the front of the boilers, prior to breaking up, and flowing to each of the six burners. The steam issuing from the burner opening carries with it and breaks up the tar which becomes ignited in the inside of the furnaces. The outflow of air is regulated by turning segmental slides on the truncated cone casing of the apparatus; both of these systems work very well. The boiler draft is provided under normal working conditions by the blowers of the driers, but there is also a piping provided with sluice valves which enables the products of combustion to be led away into the chimney.

The water for the boilers is obtained in part by the condensation of steam and in part from the River Goro, after purification in a Lassen & Hjort apparatus, the characteristic feature of which is the fact that the demand of the substance required for purifying is automatically regulated by a kind of automatic oscillating scale. This apparatus may be said to be one of the very best of the many systems available for industrial purposes and purifies the water in such a way as to render it drinkable and bacteriologically pure, in addition to making it soft.

The electric power station consists of two Tosi-Oerlikon turbo alternators of 1,000 amperes, 225 volts, 50-period, 3-phase, and 3,000 revolutions, with exciters on shaft, and working at 12 atmospheres with steam at 300° C. and three exhausts. One of these groups serves as a reserve for the other. Preference has been given to this type as the exhaust steam is completely utilized in the gasification or in the concentration of the sulphate, and the steam obtained is pure, dry, and free from oil.

At a working rate of about 6 tons an hour of gasified peat, about 6,000 kilograms of steam an hour is required for the two services, and the whole of the plant has been designed and proportioned in such a way as to eliminate all wastage and all deficiencies. The consumption of the turbo alternators is such as to require the whole of the steam needed for the production of gas and sulphate. With free exhaust the turbines consume from 16 to 20 kilograms of steam per kilowatt-hour, but this steam may be considered as costing nothing as it would have had to be produced for gasification of the peat and for concentration of sulphate.

The whole complex system of motors in connection with the

plant requires 900 to 1,000 amperes and 225 volts, and the turbo-alternator is practically always working on full load. The daily consumption of the plant is about 7,000 kilowatt-hours. The air required for cooling the alternators is filtered, and in addition to this the hot air issuing from the alternators and the whole of the heat emanating from the piping, which is fitted below, are drawn in by one of two centrifugal electric-blowers intended to raise the air to the pressure of about 1,000 mm. required for gasifying purposes. The aforesaid two electro-blowers (one serving as a reserve for the other have consequently been installed in the aforesaid underground room immediately below the hot-air outlet of the alternators.

The switchboard is arranged for three groups. It has moreover a panel for emergency, the current for which is insured by a motor-dynamo group in addition to the ordinary exciters. Other panels with automatic switches control the various power and light circuits.

The main bars of the switchboard are composed of multiple copper strips and are arranged for a current of 2,000 amperes. Recourse has been had to low tension to promote safety, in view of the contiguity of the motors. For services further afield, such as those in connection with the peat bed and the agricultural establishment, the pressure is increased to 2,500 volts.

As to the daily output, it is calculated that the quantity of gas required will be that developed by 50 to 60 tons of peat, but approximately 30 to 40 million calories is recuperated per day in the products of combustion, which are utilized in the driers.

Thus, of all the gas produced, there remains a not inconsiderable proportion which for the time being is burned, but will subsequently be sold to neighboring industrial establishments, or used in the other establishments of the Company, that is, for making briquets or compressed peat and fertilizer.

As can be seen, nothing is lost in this plant, which is a typical example of closed cycles of recuperation. The peat produces the gas and with the gas the peat is produced, that is to say, dried. With the gas steam is produced, and this steam, after having generated the electric energy required for all the services of the installation, serves to produce the gas. The heat of the gas serves to heat the washing water, which in its turn is cooled by heating the air required for gasification. It is obvious that plants of this kind must be designed with the utmost attention to details, and with a thorough knowledge of all the factors involved, as trifling errors in design would suffice to break the continuity of the cycles, and then everything would come to a standstill in no time. A mistake in projecting plants of this kind might be the cause of technical and financial failure.

The old establishment (which, however, has been scarcely six or seven years in existence) taken over from La Codigoro Company still continues producing fertilizer and compressed-peat briquets to supply the market demand for these products. It comprises the boilers (two of 100 square meters, of the Cornish type, and one of 170 square meters, of the Babcock type) that once had special furnaces for burning peat direct, but are now capable of burning coal, gas, or tar, and the mill for grinding the peat and reducing it to the finest powder, with elevators and conveyors, the Zeitzer steam driers for drying to the utmost extent the peat dust, and the briquet presses. In addition to the fore-

View of Humus and Briquetting Factory.

going there are two horizontal steam injectors for the control of the transmission and of one alternator. Without stating here how the industry was carried on formerly, we would point out that at the present time the débris of peat already dried is utilized and in case of need rendered drier for the purpose, by means of the Zeitzer apparatus, prior to being ground for the purpose of obtaining the humus or fertilizer, which is used for mixing with other animal manures or with calcium cyanamide, though it is of itself a good fertilizer, as it is rich in nitrogen. For making briquets almost anhydrous peat powder is required. The powder is automatically fed to the stamper of the steam process, the briquet, compressed to 200 kilograms per square centimeter, issuing from the press with a specific gravity of 1.3 to 1.5.

The boilers serve mainly as a reserve for the new plant and are lit up with the Tosi boilers from the electric power station. As they are capable of burning coal they are used in the preliminary work of the plant and constitute a safeguard in the event of there being any accidental break in the closed circuit of the installation, as they will aid in remedying such a break.

The alternators serve almost exclusively for the outside

service, that is, for the equipment required in working the peat-bed and the ground for agriculture, which is fed by the 2,500-volt transmission. The equipment mentioned comprises the electric plow, the Wielandt machine, and the peat-bed draining pumps.

There is electricity everywhere and at least 50 electric motors have been installed for the working of all the various apparatus, hoists, conveyors, blowers, pumps, transmission, etc. Four main circuits feed the motors, and two circuits serve for lighting purposes. Almost all the main motors are provided with maximum switches. The motors are practically all from the same firm, and of a high type of efficiency so that a small reserve is sufficient to insure the various services.

The water service, like the electric one, is of great importance, the quantities of water required are very large. The water is taken from the Goro Canal, which is 600 meters from the establishment. The water is soft and is purified before being used for the boilers and locomotives, and for other purposes. There is a workshop well equipped with machines, tools, and forge, as well as all the necessary appliances for oxy-acetylene welding and cutting. This workshop has done the whole of the erection work and fashioned part of the iron work employed.

It has likewise been necessary to establish and equip a joinery, which has also rendered splendid services in accelerating the work of construction. The remoteness of centers of habitation and the considerable quantity of mechanism and manufacturing buildings to be kept in good condition render these workshops indispensable. Transportation is as a rule effected by water along the Bella Canal, which is in communication with Ferrera. A special stage serves for loading and unloading.

The company has at its disposal two large iron barges, and also avails itself of local boats. The tramway at Codigoro, which is 7 kilometers from the plant, can be reached by land, and it is used when the navigable waterways are obstructed. Transportation on the premises is always effected by means of the narrow-gauge railway, and a complete network of tracks enables the trucks to go everywhere. The general storehouse is in a large building built for the purpose, and is amply equipped with a reserve of working material. The storehouse for the sulphate of ammonia was likewise built for the purpose, and is capable of containing 15,000 to 20,000 quintals of sulphate of ammonia. The flooring is of asphalt throughout. It opens direct to the loading stage of the Bella Canal. Part of the area is enclosed and intended for the railway plant and for the accommodation of raw materials. Numerous weighing machines along the tracks facilitate the checking of the movements of material to and from the storehouse.

Within the precincts of the establishment are the office building, the porter's lodge, the garage, and the stable and immediately outside, the building for the accommodation of the manager. At a distance of about 400 meters there is the small compound on which are seven houses, each of four to six rooms. In the compound also are an orchard and a bakehouse. The majority of the workmen live in the compound.

The waste water is led outside the establishment, and in order to avoid the necessity of utilizing the Bella water (which is blackish and full of harmful substances) for domestic purposes, two enormous filtering and settling tanks of an area of over 10,000 square meters have been provided to the west of the building. The whole establishment covers an area of 90,000 square meters, 20,000 of which is occupied by the manager's house and the settling tanks, and 70,000 by industrial buildings and machinery and storehouses.

From various points the establishment has the appearance of a small town, and as a matter of fact it is one, if one thinks of the number and importance of the buildings composing it, and the extent of the machinery contained therein.

All precautions have been taken to provide against accidents, and there is a special room arranged at the porter's lodge for first aid.

Numerous extinguishers of the "hand" type, as well as fire hydrants and pump devices mounted on trucks, are available in the case of fire.

The officials charged with developing the land from which peat has been removed, in addition to supervising the areas to be excavated in the course of time, devote attention to the systemization of the ground that has already been worked. The bottom on which the turf peat rests is of a clay and is of rather undulatory nature so that it would not lend itself to cultivation should all the peat be removed.

The peat must, therefore, be so removed that the ground remaining can be easily leveled, the surface throughout its whole extent being higher than that of the higher floods of the adjacent canals, in order to comply with the provision of the law and not interfere with the plan regulating cultivation. As previously stated, the work of preliminary study has already been carried out and the drains to be provided in order to facilitate a flow of the water have already been planned.

As soon as the bottom has been leveled and the canals have been opened, provision has to be made for deep plowing, which is done by means of a Violati & Tescari electric plow, and by ordinary plowing, and the treatment of the land with chemical manures and other substances of a similar kind has to be planned.

As the project is being developed experiments are being made as to the best methods of cultivation, and in time the area will be divided into small plots and the requisite workmen's houses built in order to invite the services of a good class of workmen. The company has arranged a model area of about 100 acres where details relating to the farm lots have already been systematized.

The work in connection with the Codigoro plant began in October, 1912. At the end of December the producers were erected. Between January and May, 1913, the whole of the plant was finished and erected, and on June 12 the producers were fired.

The Codigoro plant, as well as that of Orentano, demonstrate in the most convincing manner that substances such as peat, considered by many to be valueless, may, if suitably treated, be converted into riches, and that a solution of the complex problems of the cultivation and draining of peat beds may in every case be obtained when the problem is studied by those who are thoroughly conversant with all the difficulties. Such solution may, moreover, greatly assist in the solving of another problem of the utmost national importance, namely, the cultivation of marshy land, including peat land. It is only by continuing the peat industry that profitable cultivation of the peat beds can be hoped for, and such coordination may result in rendering remunerative a work of improvement, which is considered as an unproductive undertaking, both for the state and for the parties interested, during the initial period and right up to the completion of the improvement work.

The possibility of having available powerful sources of heat free of charge, or almost so, would render practicable also the establishment of many industries, which today cannot exist, owing to the heavy cost of coal, and to which hydro-electric energy can offer only slight profits—industries for the transformation of the products of the soil or mining industries, which today must confine their energies to the enrichment of their products for exportation purposes to the end that countries rich in coal may work them up and return them to us at enormous profits.

A Definition for Peat*

At the annual meeting of the Feed Control Officials, held in Washington recently, one of the subjects before the meeting was "A Definition for Peat." This at the request of several members from southern states, who have been asked to register in their states, a manufactured sweetened stock feed containing, as one of the ingredients, humus, a prepared material from peat. This registration and permission to sell in their states a feed containing peat, was opposed by several State Feed Officials, on the grounds that peat had no feeding value and should not be permitted in a feed.

Mr. John Wiedmer, president of the Wiedmer Chemical Company, of St. Louis, was granted a hearing before the Executive Committee of the meeting above referred to and presented the following to them for consideration:

We know of no better way in trying to aid you in giving a definition for Peat, than by referring to him whom we think is the best and ablest authority on this subject in the United States, and probably in the world, one who has practically made Peat a life study, and who has, more than likely, visited and personally examined more peat bogs, than any other person known: we refer to Prof. Charles A. Davis, of Washington, D. C. He is known by all those interested in peat as the Peat Expert, and is, himself, an able chemist, also a very impressive writer. Professor Davis is the Fuel Technologist of the Department of the Interior. Bureau of Mines. In 1911 this Bureau published a Bulletin, No. 16, entitled "The Uses of Peat," written by Professor Davis; he has also for the past eight years been, and is yet, the editor of the Journal of the American Peat Society. His knowledge is not only on peat of this continent, but we know personally that he has visited many peat bogs of the European continent, studying their physical conditions and texture of the various peats, uses, etc., as an official and expert for the United States government. Hence, we feel that we are justified in referring to him as an authority. In the above named Bulletin No. 16, page 180, he says:

"In Europe peat mull and peat litter prepared from moss and sedge peat have been used as the basis for the preparation of certain kinds of commercial stock foods. The chief ingredient in these preparations besides the peat is the uncrystallized residue, or molasses, from beet or other sugar factories. This molasses has a certain value for fattening stock, but it is difficult to feed because of its stickiness and liquid condition, and the peat is added to obviate these difficulties. Actual analysis, however, by

*From Commercial Fertilizer.

reputable agricultural chemists, show that this material has a twofold use—it is eagerly eaten by the cattle and thus stimulates them to eat more than otherwise they would of fattening food; the peat also neutralizes certain bad effects of the molasses so that larger quantities may be eaten. Although the weight of evidence gathered at agricultural experiment stations in the United States seems to show that condimental stock foods of the kinds usually sold are of the nature of stimulants and do not give sufficient returns in actual gains in weight or condition of the animals to justify such use, the testimony as to the value of a mixture of molasses and peat mull as an addition to the ration of horses and other live stock seems conclusive. Reports of its beneficial effects have been issued from time to time through a number of years from various European countries and from army veterinarians of Germany and England."

Professor Davis does not state how peat is prepared for the purpose as above set forth. From the writer's personal knowledge, gained from visits to several European countries, the majority of mixed feeds sold in Europe are cooked, but it is not known that any feed containing peat used in these foreign countries is cooked. The first manufacturer, to my knowledge, who used peat in stock feeds in the United States cooked his mixture of molasses and peat before mixing his entire feed (name given if wanted). I am told by a large manufacturer of sweetened feed, who is also an actual stock feeder extensively using his own make of feeds, that before using our humus prepared from peat, he tried raw peat, sun dried, from Canada, Michigan and Maine, mixing it into his feed without cooking, as he now uses our humus, but it gave him no results as he finds our humus is giving him. As to what he has to say we refer to page 9, article marked "A" of our pamphlet submitted herewith.

I will now attempt to tell you what we mean by saying our humus prepared from peat. First a word as to our peat bog. It was drained in 1882 to the depth of a peat soil, by large open ditches that carry the water six miles distant to a tributary of the Illinois river, and ever since that date the land has been, and still is, under a high state of cultivation. I hold that this cultivation for 32 years has removed the wildness and rawness which the peat has in a bog, covered with water almost the entire year, such as those most of us are familiar with. We gather this peat and in mechanically drying it pass through gases heated to about 1,750 degrees so that whatever wildness or rawness there may still be in the peat after all these years of exposure to sun, frost and cultivation is certainly eliminated, as well as any germs, and at the same time the charcoal effects which we claim for our material are produced.

It may seem strange to you that we do not recommend that a large per cent. of humus be used in the sweetened feed. Careful experience and close observation has shown us that 10 per cent. humus to 90 per cent. of molasses is about the proper proportion in which to use the material. Thus if a manufacturer uses 50 per cent. of molasses, his feed should contain about 5 per cent. of humus; 25 per cent. of molasses, 2.5 per cent. of humus, and so on. The idea of choosing these proportions is to counteract the bad effect of molasses, such as souring, belching and bloating, at the same time eliminate a good part of the stickiness naturally caused by the molasses, and also to prevent the caking of the manufactured feed. The price the manufacturer pays for humus will not justify his buying it as a filler or an adulterant, as he can, for these purposes, buy much cheaper articles. However, the best reason, in our opinion, why humus, peat or muck—call it what you will—should be used, is the simple fact that the actual feeders are demanding of the manufacturers who sell them a sweetened feed that it shall contain humus. These practical stock feeders know by actual experience that the humus combination is benefiting their stock and their demand is causing those manufacturers who do not use it, to consider introducing it to enable them to sell the feeders to whom they offer their goods. The actual feeder in these very few years (about five years now) is fast becoming acquainted with humus and realizes how it is increasing his bank roll not only in hastening the fattening of his market stock, but in the general health of all his animals. A mare, cow or sow with healthy digestive organs will certainly deliver a better offspring and be better able to nourish it than such as are poorly nourished because of disordered digestion. The general health proposition is just what is creating the demand for humus.

Now, gentlemen, this is the reason we ask you to allow a manufacturer of sweetened feeds to mix into his product from 2 per cent. to 5 per cent. of humus according to the amount of molasses he uses, and register and sell to stock feeders, within the limits of your various states.

Gentlemen: I beg your indulgence for a few moments longer as I would like to say a word or two, especially to those of you from the southern states as well as the states bordering on them on the matter of feeding cotton seed products. You noted what our friend from Texas says; that he is manufacturing a feed that contains no grain whatever, the whole basis thereof being cotton seed products in connection with molasses and humus. It is my firm belief that if you people will admit the registration and sale of a mixed feed containing humus, that within a very short time your stock will be fed entirely on your principal product, cotton

seed meal. In this connection, however, it would probably be well to use a little more humus than with a grain feed, as you all know cotton seed meal is too strong to feed without a very careful balance. This balance can be made with the hull of the seed in connection with your native grain together with molasses and humus. With such a ration you con not only fatten your stock, but, you can also feed your work animals, dairy cows and all breeding stock the entire year round, with just as good results, if not better, than are being obtained with the feeds in use now. It seems reasonable from such consideration that as you would be benefiting not only the feeders of stock by allowing the use of humus, but also the raiser of cotton, which is the principal farm product of the southern states, you certainly should take into consideration this, while passing upon such an important matter as the admission of the use of humus, or the product of peat, in the feed.

We beg to submit all papers herewith for your further consideration on the subject referred to. You will note in our pamphlet under the heading "For Fertilizers" what a hard time we had to establish the use of our product as a plant food. Many of you, no doubt, know what a factor it is in the price of a commercial fertilizer. As humus has aided the farming people of the majority of your various states as a plant food, so, gentlemen, in guarding the interests of your people, "Your Duty," give all a square deal; your people as well as the manufacturers of humus or peat.

I close by saying to those of you who are not convinced by what we submit, in justice to your sense of fairness, before condemning the material on mere prejudice, be honest to your official position and give it an actual test, not through a laboratory, but through the animal's stomach, and if that is found lacking in benefit then condemn it for good."

Peat Exhibit in the New York Flower Show (March, 1915). The Alphano Humus Company had a booth filled with flowers grown in soil mixed with Alphano peat humus, but the special feature of their exhibit was fifty boxes or flats of lawn grass approximately six weeks old. The mixture used was ordinary soil and Alphano peat humus. There was no such grass anywhere else on exhibition. It was free from weeds, of strong, healthy growth and the fibrous roots had completely filled the soil in the boxes in that short space of time. Grass experts declared it to be a proof of the value of peat humus, when properly applied, for the growing of lawn grass.

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EDITORIAL NOTES.

Publication of the Journal. The irregularity and delay in the publication of this Journal has, no doubt, caused many of those who read it much annoyance and some wonderment as to why the delays occur. The Editor frankly assumes the blame, and acknowledges that the fault is his. The work has to be done, however, at odd moments and at times which, by most of us, are usually devoted to diversions rather than to work; i. e., what is ordinarily termed "leisure time," or the hours not required by regular and more remunerative occupations. During the past year sickness and other cares have so largely encroached on the spare time of the Editor, that there has been little time available for editorial work. Other factors, such as the scarcity of usable matter to print, and the difficulty of obtaining new information from correspondents, have contributed to the difficulty of publishing the Journal on schedule time and in worthy form.

Various changes are under consideration by the Executive Committee and as soon as they have been arranged for, they will be announced in these columns. In the meantime it is hoped that the members and others interested will have patience and continue their loyal support to what is, with a single exception, the only periodical publication on peat and its uses in the English

language. Plans now being worked out promise to make the Journal of more interest than ever in the near future.

The Preservative Power of Peat. The preservative power of peat has recently engaged attention in the columns of "The Scotsman" and an interesting illustration of it came under observation some time ago in one of our northern glens. There is extant a letter, written by General Monk to Cromwell during his operations in Scotland. It takes the form of a dispatch, and relates that in accordance with general orders to reduce to quietness the northern districts of Scotland, he passed up through Glengarry, burning on his way Invergary Castle. On reaching the head of Glen Strathfarrar in the evening, he reports that he lost his way, and, landing in a bog, he had the misfortune to lose, in the quagmire that engulfed them, 200 horse. So far the letter. A distinguished authority on local history, tradition, and natural lore informed the writer that not far from Branlen there is a place called "Corrieach," the "Horses' Hollow," "each" being the Gælic for horse, and further, that a gamekeeper had reported to him that not a few Englishmen, tourists and sportsmen, who had visited Branlen, had often remarked to him on the number of horses' bones that were in the peat, and had asked of him the explanation, which he could not give. There can be no doubt that the preservative power of the peaty soil is here manifested. (W. C. M. in The Scotsman, Edinborough, communicated by C. Lindley Wood.)

At the same time Mr. Wood sent the note from the Scotsman he reported the following personal experience:

"On the bog at Dumfries in Scotland, which I used to control, there was exposed one day by the peat cutters, the body of a man, which turned out to be the body of an English foot soldier. The body was about 6 feet from the surface of the bog and was in a remarkably good state of preservation.

"Although the body had been decapitated, all features were perfect. The soldier had no doubt been killed by the Scotch, during the border warfare, and buried by his comrades. The man wore leather sandals and a leather loin cloth, which were all intact when found. The body was reburied in the local churchyard on the same day it was found.

"The bog is called 'Lochar Moss,' from the Scotch word 'Loch,' meaning a lake, and no doubt it was once upon a time a huge lake. The bog is now about 13 or 14 miles long by 3 to 4 miles wide, and in the center it is about 70 feet deep.

"We also found in the peat of this bog many sets of bones of stags and deer, and large numbers of bronze arrow and spear points."

Abstracts, Patents, Etc.

Dr. Herbert Philipp, Editor

Is Liming Peat Soil Harmful? In 1913 Densch was of the opinion that the rate of reduction of nitrate in the soil to the nitrite was regulated by the lime, too much of which resisted any quick reduction. This opinion he further modified by the results of his experiments which showed him that the stage of the soil decomposition played a role. It has now been demonstrated that this reduction process, which has always been considered a chemical one, is far more a bacteriological one. After sterilizing a portion of soil either by heat or sublimate the nitrite formation did not take place, but started again after the sterilized soil had been inoculated with fresh soil. In these experiments the bacterial action of the soil is shown. (Densch and Arnd, Zentrbl. f. Bakter and Parasitenkunde, 1914.)

Drying Peat by Natural Pressure. Alfred Born. (Ger. Pat. Application 61,621, Nov. 19, 1914.) The process consists of dredging peat, laying it out until it has lost enough water so that it will stay in separate pieces, or will not flow any more, when it is stacked in rows about 3 feet high, and then, both the dry and wet material is equally spread out to a high stack, about 25 to 27 feet high. The peat contains thus about 80 per cent moisture. After a time the peat on the bottom starts to heat itself, and reaches by degrees a temperature of 82° C. The peat loses water all through the mass. This effect is not produced by using very dry or very wet peat. The inventor claims that this method is much cheaper than artificial drying.

Preparing Peat. W. L. St. J. and J. R. H. Prioleau, Br. Pat. 20,668, (1913.) Dense peat fuel, from which coke may be made in ordinary beehive ovens, is prepared by passing the raw material from a bog through a disintegrator into a steam-jacketed chamber, and thence in a thin layer between hot rollers, preferably revolving differentially to exert a rubbing action. The material thus reaches a temperature of about 30° C., sufficient to render it sticky without removing volatile oils and to reduce the moisture slightly, say from 90 to 70 per cent. The putty-like material is moulded immediately, under very slight pressure, the resulting porous lumps or blocks being rendered hard and dense by a subsequent slow drying, which takes place in chambers, dur-

ing several days, in a current of air not above 30° C., rendered somewhat moist by the operation.

EFFICIENCY OF PEAT FUEL FOR STEAM GENERATION.

The efficiency of this fuel in comparison with others is at once questioned when its use for the generation of steam under boilers in manufacturing establishments and power and lighting plants is proposed. If trial by the owners of such establishments demonstrates that the same money spent for any other fuel will give a larger quantity of steam, or more heat units than will peat, or will insure a more readily obtained and certain supply or even one more in favor with the men who handle it, the probabilities are that other fuels will be given preference and used exclusively. For these reasons peat-fuel manufacturers will have to make the best possible showing by producing a fuel that is cheaper and more convenient to use and very efficient as compared with types already on the market. They must also be able to provide an abundant and steady supply the year round if they expect it to be generally used for power purposes, as it must be if large investments in peat fuel are to be profitable.—C. A. Davis in Bureau of Mines. Bull. 16.

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The Herbein Process for Making Briquets From Peat, Petroleum, and Binder

By Robert Blei, Sacramento, Cal. *

The constantly growing demand for fuels for industrial and domestic purposes, and the advancing price of all fuel commodities has caused economists, scientists, and others to seek and appraise new sources of fuel supply, and to contrive means of conserving and more perfectly utilizing the present supplies.

The tendency toward more efficient utilization is shown in the development of interest in means of saving fuel waste, peat, and combustible material by briquetting.

Until now no one has conceived the proper combination of materials and chemicals to accomplish the end that all nations have so long sought—the concentration of high heat value, at a minimum cost, with no perceptable ash increase. Although Europeans and investigators the world over have been striving to evolve a method of treating the abundant supplies of peat so that it would make a satisfactory fuel, it remained for an American, Dr. George W. Herbein, to so combine the high heat value found in crude petroleum with the low heat value found in peat, together with binding material costing only a few pennies, that the increase in added ash with this binder was only 0.001 per cent.

In Holland, Germany, Russia, Belgium, Norway, Sweden, and in fact all of Europe, peat has been in use for fuel in raw and crude ways for centuries, its chief objectionable features being the dust produced in handling it and the great bulk that must be handled as compared with the lesser dust production and greater compactness of the various kinds of coal. Dr. Herbein's process of treating peat overcomes the objectionable features mentioned, and the inventor has recently directed his endeavors toward producing a smokless fuel. At present every European country having any considerable area of peat is increasing the output of peat fuel; in addition, Ireland, Canada and the countries of Conti-

*Read at the Duluth meeting.

nental Europe are encouraging its use by direct appropriation of funds to aid new and promising methods of preparation.

It is not the purpose of this paper to go into the details of peat mining and drying; it is necessary only to so dry peat by exposure to sun and air that its moisture content will be reduced to 25 per cent.

Crude petroleum, residuum oils from petroleum refineries, heavy oils, or waste oils, are all that are necessary for the production of "Herbein Koal." Such oils are cheap and often a drug on the market. Heavy asphaltic base oils from California, Oklahoma, Texas, Cuba, Mexico, and Russia, f. o. b. the Pacific Coast, the Atlantic Coast or the Middle States, in order of their notation, cost per barrel 65 cents, $1.20 or $1.44.

Dextrine, a product of corn, commonly used for the manufacture of cheap mucilage for use in paper making, printing of cloths, and coating paper envelopes and stamps for adhesive purposes, costs $3.40 a hundred pounds.

Ordinary slacked lime, produced by burning limestone, costs, according to locality, from $8 to $14 per ton.

Primarily it is and was the object of the inventor to find a cheap and nonash-producing binder. How well he has succeeded is evidenced by the fact already mentioned that the ash added in his process amounts to only 0.001 per cent per ton. His entire binder costs less than 8 cents for each ton of briquets, yet many fuel engineers pronounce the fuel produced to be hard and of desirable form for market, burning freely under easily regulated stoves without breaking up and disintegrating in the fire box, and, unlike pitch, asphalt, or tar binders, it gives off only a moderate quantity of soot. In some coal-briquet binders we have magnesium chloride which is found in burning to form a coating of film or surface on the briquet, smothering or putting out the fire in the stove or fire box. Pitch, asphalt, or tar binders have the objection of forming too much soot. In fact, the writer has seen in furnaces great strings of soot or distilled pitch, which clogged the drafts, stove pipes, and chimneys.

The fact remains that coal briquets seem yet in their infancy. A magnesium chloride binder forms a film; pitch binders, it is true, make a briquet, but it is not hard enough for transportation, and while magnesium binder holds, it seems to hold too well. The film formed over the briquet in the stove or fire box smothers the fire, whereas pitch of any nature spells so much soot, forms at best a fragile briquet that disintegrates in transportation and smokes in burning, not to speak of the great cost of 8 to 10 per cent of the total cost of the briquet, or $1.40 to $1.60 per ton of briquets.

Let us see what happens in Dr. Herbein's process. To the

air-dried peat is added crude oil, dextrine, and lime, and the mixture is compressed into briquets, which are hard, dense, black, durable, unbreakable in transportation, and burn freely with a long, clear flame. This long flame, indeed, passes completely around the oven in cook stoves and ranges. The briquets ignite readily, and when the drafts are properly arranged, burn slowly and evenly, producing no soot. The briquets do not disintegrate in the fire box like other fuel, but on the contrary, retain their form and shape. The ash, amounting to only 6 to 8 per cent, is fine like wood ashes. As no sulphur is present, there is no erosion of fire box or grates from their use, and, unlike other fuels, the briquets produce absolutely no clinker.

The process produces an artificial coal yielding 10,000 to 11,500 B. t. u. per pound, according to the amount of crude oil added, the cost for binder being only 8 cents per ton, and the cost of the finished fuel being about $1.15 to $2.15 per ton, as against $4 to $5 for coal briquets.

Summarizing, briquetted fuel, to be successful, must be hard, durable, show little or no breakage in transportation, contain no sulphur, must not disintegrate in burning in stoves or under boiler, must produce no soot, odor, or clinker, and must contain not more than 6 to 10 per cent of ash.

The briquets produced by the Herbein process have been thoroughly examined and passed on by engineers the world over, and I feel that in presenting this fuel, I lay before you a form of peat fuel that the peat industry has dreamed of, and has striven to produce in this country and in Europe.

PRIMITIVE USE OF PEAT.

The earliest use of peat was for fuel, and dates back to the dawn of history. Latin authors of the time of the conquest of northern and western Europe by the Romans commented on the miserable condition of some of the people of those regions, who dug the soil from their marsh lands with their hands, and, after drying it, burned it to warm themselves and cook their food. In Ireland, of necessity, peat has been the only domestic fuel of the mass of the people from the traditional time when the forests of that country were finally cleared away.

Scarcely less ancient is the use of peat for fuel in other parts of northern Europe—Holland, Germany, Russia, and parts of France and Austria. The disappearance of the forests at a comparatively early period, while agriculture was the most important industry of these countries, led to the widespread use of peat fuel, especially by the poorer classes of people—C. A. Davis in Bureau of Mines. Bull. 16.

Peat in Iron-Ore Industry*

By Peter Christianson

Attention is called to the possible uses of peat in connection with the iron-ore industry:

1. On account of the proximity of the peat and ore deposits in the Lake Superior district.

2. The desirable utilization of worthless iron-bearing material thus effected.

3. The utilization of peat bogs which are usually regarded as waste areas.

All processes for concentration of the ores require power. Peat is primarily a low-grade fuel which economically will not bear transportation. However, for power purposes the transportation problem of peat is not a serious obstacle.

For power purposes a peat power plant should be located at the peat bog, and should consist of the following parts:

A plant for producing machine peat; a gas-producer plant for gasifying the machine peat and making producer gas, and gas engines coupled to electrical generators. By this scheme the peat is converted at the bog into electrical energy, which may be conducted without undue loss to any reasonable distance and utilized as power at the concentration plant.

Use for Heating Operations.

Drying, roasting, calcining, and sintering operations are becoming more and more important. Taken collectively it may be said that these operations are partly for concentration and partly for physical betterment of ores. Of these operations, drying requires the lowest temperature and sintering the highest, while roasting requires an intermediate temperature together with a regulation of the furnace atmosphere. There is no inherent reason why peat could not be utilized as a fuel in all these operations; and the proximity in many places of the peat and ore deposits makes this seem reasonable as a commercial proposition. Machine peat could readily take the place of coal, but it should be noted that the heating power of peat is only about one-half that of good soft coal. Therefore, the grate area necessary for doing a given amount of work must be nearly twice as large for peat as for coal. This method of burning peat requires the simplest preparation of the fuel. In fact, its preparation is identical with

*From a paper presented August 20, 1914, before the eighth annual meeting of the American Peat Society, Duluth, Minn. The author is instructor in metallurgy, Minnesota School of Mines, University of Minnesota, Minneapolis.

that used in preparing peat for power purposes. Hence the same peat plant, if of sufficient capacity, will serve both for power and heating purposes.

The method of burning peat in a powdered form has recently been perfected. It is being used in Sweden for firing locomotive boilers, and is easily adapted to the firing of the cylindrical furnace used for drying, roasting or calcining. In fact, this method of using powdered fuel was first applied to the horizontal cylindrical type of furnace. The cost of preparing peat in a powdered form is fully twice as high as that of producing machine peat. However, the use of powdered fuel is more economical and a higher temperature is obtainable. Hence for high temperature operations, such as roasting, calcining, and sintering, it may be advantageous to use peat in this form.

Still another method of using peat for heating purposes is that of making it into producer gas and then burning this gas in furnaces used for drying, roasting or sintering purposes. For example, in one process, the fine ore is first made into briquets. The briquets are ignited at a high temperature in a furnace characterizing the process. The fuel used is producer gas burned on the recuperative principle. It is suggested that this producer gas be made from peat, provided a suitable supply is located near the briquetting plant.

Peat as a Binder for Ore Briquets.

Pure or nearly pure iron oxide as it exists in a finely divided condition or as a concentrated product has no plasticity nor coherence. In order to agglomerate such material at ordinary temperature, it must be mixed with some binder. The plasticity and binding properties of peat are quite characteristic. This is particularly true of the best grade, which is dark or nearly black in color. This grade of peat, containing about 75 per cent moisture, thoroughly macerated, has an unctious feel and will dry into a coherent mass which will stand considerable wear and tear before breaking into pieces. In fact, it is this binding property of peat which makes the manufacture of machine peat possible.

The writer has recently made some experiments at the Minnesota School of Mines Experiment Station. Fine concentrates were mixed in varying proportions with peat containing 75 per cent moisture. These mixtures were made into briquets in a manner similar to that used in the manufacture of machine peat. Samples of the briquets contained 12½, 12¾ and 15 per cent of equivalent dry peat. All of these exhibit a rather remarkable degree of toughness and resistance to wear. If heated in an oxidizing atmosphere, the briquets immediately crumble, but in a reducing atmosphere like that of a blast furnace they retain their

shape rather persistently. To determine the mechanical and physical properties of these ore-peat briquets, a series of tests is being conducted by the writer at the Minnesota School of Mines Experiment Station, but the experiments are not complete.

The impurities introduced into the briquets by the use of peat as a binder would be a minimum, first, on account of the small percentage of peat used, and, second, because of the small percentage of impurities. The total foreign or slag-making constituents added in the binder, assuming 10 per cent ash in the peat and 15 per cent dry binder in the briquets, would equal only 1.5 per cent.

Possibilities of Peat for Smelting.

From the published analyses as well as from a few made at the experiment station, it does not appear that peat charcoal can take the place of wood charcoal in the production of charcoal pig as conducted at the present time. However, there is so much variation in the analyses of peat that each bog would have to be sampled, and the samples analyzed, in order to determine the probable value of the bog in this connection.

If peat could be made into a coke having the requisite hardness, there is no doubt that this coke could be used in the production of coke pig iron. It is only a question of making the peat into a suitable coke. There is a possibility that a smelting practice, intermediate between the present charcoal and coke, would be developed by the use of peat coke; and this might modify the resulting pig iron, so that it could take the place of the present charcoal pig.

One more contingency may arise in which peat may be used in the smelting of iron ores. The time may come when electric smelting may become an important factor in the production of pig iron. Even at the present time, electric smelting is being introduced into some localities with considerable success. In electric smelting, electricity is the source of heat, but some form of carbon must be presented to reduce the ore. As the process is conducted at the present time, wood charcoal is the most efficient form of carbon for reduction. Coke is too good a conductor of electricity and interferes on account of its conductivity. For this purpose, peat charcoal, if available, can doubtless take the place of wood charcoal when this has been exhausted

DISCUSSION OF PROFESSOR CHRISTIANSON'S PAPER

Discussion following this paper was rather general, and was participated in by a number of the local visitors, who were largely interested in the iron regions tributary to Duluth.

Mr. Kleinstück pointed out that the processes discussed in Prof. Christianson's paper were well past the experimental stage. Although there have been experiments along these lines for many years with more or less success, present-day research shows most important and satisfactory results, particularly in reference to the fuel value of soft coal in comparison with the heating value of peat briquets, with the advantage on the side of peat.

Prof. Davis emphasized the capability of peat in the matter of heat production, some commercial coals running scarcely more than 12,000 British thermal units, and according to Bureau of Mines analyses, some peats run as high as 10,000 to 11,000. As to cost, he stated that consideration of the best coal and the poorest peat would hardly be fair. He gave it as his opinion, however, that the average heating value of good commercial peat would be 9,000 B. t. u. as against 13,000 B. t. u. in bituminous coal, peat, however, having the advantage because of its freedom from clinkers and ash, and the absence of waste from soot, besides the well-known heat-absorbing properties of coal ashes, whereas the quantity of ash from peat fuel is practically negligible.

Inquiry was made as to the time that peat material should remain out of the ground before put into the mill, which was answered by Prof. Davis to the effect that the best results required drying for at least an entire summer.

Another question was whether it is better to use the powdered product, which was answered to the effect that peat fuel in the form of well-burned charcoal will give the highest efficiency, and that its preparation should receive great care. There is no reason why pure peat fuel should not be used for many purposes. The best results with powdered peat have been obtained in Sweden—results in boiler firing, etc., as good as good English coal will produce being reported. The peat powder that, in the Swedish peat regions, costs $1.75 to $2 a ton, when burned in special burners, is as efficient as English coal costing $2.50 to $3 a ton.

Mr. Kleinstück said there is no question at all but that one of the greatest obstacles to peat fuel production is the question of getting a proper supply of labor, even though the highest wages are paid in the peat industry. He maintained that it is entirely feasible for a plant with a daily capacity of 50 to 60 tons to be handled by three men. The Dolberg system, however, requires a force of 18 to 20 men to turn out 80 tons daily.

Along this line attention was called to the Wielandt machine, as being a very efficient piece of German apparatus. Furthermore, the belief was expressed that the Krupp plant would be very advantageous to the peat conditions in and around the Vermillion and Mesaba iron ranges, tributary to the city of Duluth—in St. Louis County, Minn., especially in connection with the vast iron industries and mining interests of this wonderful region.

Prof. Christianson, speaking on the fuel value of peat, stated that the efficiency of the peat would, without any doubt, vary with the construction of the furnaces in which it was burned. He did not wish, on this account, to be understood as depreciating the fuel value of peat, although he was under the impression that it would be difficult to get a relatively high efficiency with the use of ordinary burners built for coal.

In the consideration of the amount of power necessary for the crushing and concentration of iron ores, Prof. Christianson stated that considerable power is required for that purpose. In his opinion the cheapest method of getting power from peat would be to generate the power at the bog and transmit it to the mines, where of necessity the concentration plants must be located, and where it is necessary to utilize the power for the crushing and concentration of the ore, which in turn would of course mean the application of power in a practical way and on a large scale.

Prof. Davis referred to having seen in Northern Germany a great gas-producer plant operated entirely by peat fuel, the plant developing 4,000 horsepower, using gas engines of large capacity. The plant was not only making gas out of the raw material, but also recovering from the gas, in the form of ammonium sulphate, one of the most valuable fertilizers—something more than 70 per cent of the combined nitrogen present in the peat. Possibly a plant of this nature and capacity would cost about $500,000, or could be constructed for about that amount. He emphasized the fact that securing good efficiency from peat fuel was largely a matter of properly constructed furnaces, as Prof. Christianson had stated, and that there are in the market today in the United States no boiler furnaces that are designed and constructed to burn any kind of peat fuel; all furnaces are designed for wood or coal burning.

Speaking of a gas-producer plant, Prof. Christianson said that on the iron ranges in this section of the country there are large beds of peat, ample in extent, and having such a large percentage of combined nitrogen as to be valuable sources of fertilizing material if burned in suitable gas-producers and the ammonia which is made in connection with gas is recovered.

Mr. Kleinstück, following the suggestions contained in Prof. Christianson's paper, stated that there is a possibility of Germany's industries, peat among others, being laid low for many years, owing to the unfortunate war conditions in Europe, and that now is our opportunity—that we should grasp this opportunity and get the peat industry on a firm basis. We should proceed to procure property rights. He referred to the wonderful increase in the values of peat lands in Michigan, which within a dozen years have increased from a few dollars an acre to $500 and $1,000 an acre.

With respect to the varying depths of peat, Mr. Schacht made inquiry as to what was the shallowest deposit that could be marketed at a profit.

Replying, Mr. Kleinstück said that 300 tons of salable peat an acre for each foot in depth of drained peat was a fair estimate; that if there is in Minnesota an average depth of 4 feet, it would be very safe to estimate a return of 1,000 to 1,200 tons of dried peat per acre. He gave it as his opinion, in this connection, that to mine deeper than 10 feet would be too expensive.

At this point an inquirer wished to know the approximate depth of peat, and was informed that it varies widely, ranging from a few feet to as high as 20 feet or even more.

Mr. G. G. Hartley, of Duluth, referred to the fact that on the Mesaba range, in St. Louis County, tributary to Duluth, there are many power plants, small, scattered units, the power for which is expensive, and stated that all through this section there are peat bogs varying in depth from 18 to 25 feet. He said that there seems to be no good reason why this peat cannot be utilized to produce power to operate these plants at a profit.

Mr. Hartley also referred to the value of peat as a fertilizer, and in this connection also suggested that although we are developing water power and taking the water from these bogs, it is a question whether we are not covering up more value than we are getting out in the form of the water power. He suggested that if we had some corporation or individuals with sufficient enterprise to go over to Germany and see what they do there in developing swamps and bogs, we would undoubtedly find a revelation, and that although we are devoting a great deal of time to investigation, there may be those who are prepared to build gas engines to produce ample power, and it would seem important

that the younger men should be alive to the possibilities of peat development along these lines.

Mr. Stein stated that it is estimated that there are over 100,000 acres of swamp lands in St. Louis, Beltrami, and Itasca counties, and that probably more than half of this area is covered with peat of an excellent and marketable quality. He estimated that there are within the State of Minnesota approximately a million acres of swamp lands, of which more than half is peat.

DISTRIBUTION OF PEAT DEPOSITS.

Peat beds are not uniformly distributed over the country, but lie chiefly in the region north of a somewhat irregular line extending westward from close to the southern boundary of New York nearly to the ninetieth meridian and thence northward to Canada. This region is supplemented by a narrow strip of land that extends along the Atlantic coast to Florida, includes the whole of that State, and reaches westward, probably across Texas to the Mexican border. In the Pacific Coast states there are some peat areas of workable size in California, and also in the valleys of some of the lakes and rivers in Oregon and Washington, but little is known of the extent and character of the deposits.

The reasons for this peculiar distribution of peat are not evident, but extended investigation will doubtless show it to be definitely correlated with certain geologic and climatic conditions which can not be discussed here.

It is an exceedingly interesting coincidence and a most important economic consideration, however, that the regions where peat is most abundant are relatively remote from the coal fields, the only exception being an overlapping of peat and coal in Michigan. In that State, however, as geologists are aware, the part of the coal field known to be commercially productive is not of large extent, but, so far as developed, is confined to small areas on the eastern and southern margins, the interior yielding but little coal. Aside from this area, the much-less marked overlapping of peat and coal in Illinois, and the slight coinciding of peat and lignites in the western border of the peat-bearing regious, there is a well-marked separation of the coal fields and the areas that contain peat.—C. A. Davis, in Bureau of Mines. Bul. 16.

Peat Industry in Emmen County (Holland)

By Christian W. Dick

The peat deposits lying in the county of Emmen, province of Drente, Holland, have an area of 19,000 hectares (23,250 acres). They form a part of the great "Bourtanger Moor," with an area of 70,000 hectares (174,000 acres), which lies partly in Dutch and partly in Prussian territory.

During the last 20 years (1890-1910), 3,000 hectares (7,400 acres) of the peat lands of the county of Emmen have already been made use of for fuel purposes. Of this 3,000 hectares, again 2,500 hectares (6,200 acres) have been made productive again for agricultural purposes, as so-called "dalgrounds."

The following main canals were built in the county of Emmen: The van Echtens canal—10 miles in length from New Amsterdam to the Prussian boundary; Scholtens canal—6 miles long; Weerdinger-Emmererfschieden canal—3 miles long; and Orange canal—3 miles long. All of these canals, of course, are connected with other main canals which are spread over all Holland.

The Noordooster local railroad runs for 14 miles along the peat fields of the county of Emmen, the Dedemsvaart steam tram goes 20 miles across these peat lands, and the First Drent steam tram 10 miles through this district.

The older moor colonies of the county of Emmen are about 50 years old, and have already 24 miles of hard roads. Through the newer parts, which are about 30 years old, hard roads 20 miles in length will be completed this year. In other moor colonies of the county 16 miles of hard roads are in course of construction.

The number of inhabitants of the new colonies, Bargeroosterveen, Klazienaveen, Emmercompascuum, New Amsterdam and Amsterdamfield, has in 20 years increased from 11,000 to 23,000. On Jan. 1st, 1914, the county of Emmen had 32,000 inhabitants. The main city of the province of Drente, Assen, had 14,000 inhabitants. The population of the county of Emmen has an increase of about 1,000 inhabitants, annually, chiefly from the growth of the population of the moor colonies.

In order to bring wild, natural peat beds "on the cut," as it is called, a first necessity is always to begin preparations by getting rid of the water. This is done by a system of ditches and side canals which connect with the main canals mentioned above. The water from the deep ditches runs into side canals and from

these again into the main canals. When all possible water is thus drained out of the peat, the layer thus ditched is stiffer and heavier than before draining. The surface of the peat field as the result of shrinking will settle down 6 to 7 feet sometimes. The thickness of a well-drained and settled layer of peat in the region is from 7 to 14 feet.

The peat which is mostly dug in the locality is the so-called mill peat, chiefly used to heat the kilns of brick factories. For preparing the fuel the digger gets paid by so-called "stick" and "dogwerk." A "dogwerk" of peat holds about 12,000 pieces or about 40 cubic yards stowed, which is about 10 tons in weight. The worth of a cubic yard stowed, of good mill peat is about 40 cents at the field. The many strawboard and potato flour mills of the provinces Groningen, Drente and Overysel use much millpeat for steam boiler firing. A small strawboard mill, for instance, day and night through, uses two dollars' worth of peat fuel per hour. Almost everywhere the heaviest layers of peat are found at the bottom of the beds; in some parts of Bargervosterveen, however, the lightest peat lies underneath the so-called "Oatsstrawkind." This is used for fire kindling in the larger Dutch cities. All buildings standing on the peatfields have to be moved as the digging progresses. A whole village, Bargercompascuum, must be removed for the peat diggers. At this town there is a school with four classes, a brick church with tower, a cemetery, a windmill, and quite a number of houses for farmers and workingmen.

At those places, where the peat is heaviest, at Emmercompascuum and Weerdingermond, county of Emmen, a well-developed industry exists for the manufacturing of peat fuel for stove heating. This product is in the form of hard, heavy pieces of peat 6 by 6 inches, and 2 inches high. The best brands equal coal in heating value. One "stobbe" of this so-called "bagger" peat holds 8,000 pieces, worth about $8 to $10 at the field. In the season extending from April to about July, 30 steam locomobiles from 7 to 12 horsepower work at this industry but only at Emmercompascuum.

To make the bagger or machine dug peat, the blocks of wet peat are ground fine in a machine; the stuff is then mixed with water and spread in a uniform layer on a flat drying field. After the most of the water has evaporated, the layer of peat is cut in pieces of the usual size, and then broken up and dried. Four to five men with a locomobile can make 400 "stobbe baggerpeat" per season. Twenty-two thousand "stobbe baggerpeat" and 40,000 "dogwerk" of other peat is made per year in the country of Emmen. It is calculated that within fifty years all peat bogs of the county of Emmen will have disappeared; instead, very pro-

ductive farms will occupy these grounds. The average price of one hectare of high peat bog, lying near a canal, is about $400. When the peat has been removed, the remaining land is worth about $300 for farming; the farmer has to spend about $150 to make the stripped land "dalground," ready for farming. The land which was formerly wild peat bog will often yield then as much as 36 tons of 2,240 pounds of potatoes per hectare.

The top layers of some peat bogs are used to make the well known peat moss litter, which is shipped packed in bales. The dried yellow and gray peat blocks are torn to pieces in a so-called "wolf," and then pressed into bales and sent to market. A great deal of peat moss litter is used for horses in coal mines. The W. A. Scholten Company have a large peat moss litter mill at Klazienaveen, county of Emmen. The area of peat bog in possession of this company is 2,400 hectares.

The Drent Landculture Company has, at Amsterdamfield, county of Emmen, also large peat moss litter mills. These are electrically driven, and gasoline motor locomotives bring the trains loaded with peat from the field to the mill. This company owns peat bogs with an area of 3,000 hectares. At Nw. Amsterdam there is another small, floating peat moss litter mill.

In the vicinity of the county of Emmen, also in "Bourtanger Moor," at Hesepertwist, Prussia, the large works of "Heseper Torfwerk" are in course of construction. One chief stockholder in this company is the Count of Landsberg-Veelen in Westfalen, Prussia. This company owns an area of peat grounds of 1,800 hectares. Peat moss litter and peat briquets will be manufactured. Electrically driven machines will do the work in the field, instead of manual labor. The factory for peat briquets is built at Meppen, on the Münster-Emden railroad. For the transportation of the peat to the factory and of the bales of peat moss litter, an aerial cable line 10 miles long is being built.

The Verhoeven Company owns peat fields of 1,000 hectares area, and runs also a large peat moss litter mill at Schöninghsdorf in the "Bourtanger Moor."

The Herren Schöningh own at Schöninghsdorf 1,500 hectares of peat bog. One part of this is used for farming on top; another part, 600 hectares, is leased to Griendtsveen Litter Co., of Rotterdam and Cologne.

On Prussian territory, at Schöninghsdorf, near the Dutch border, is erected the factory for making peat moss insulation plates, owned by the firm of Lübberman & Velema. This new industry makes plates 20x40 inches in size, any thickness, from moss peat, which are good insulators against sound and temperature changes.

In the counties of Bentheim and Lingen, Prussia, near the

Dutch border, the Krupp family, at Essen, bought 3,000 hectares of peat land and sandy ground. This whole area will be used for farming and to keep livestock to supply the army of employes of the "Kruppwerke" with everything necessary for life.

Near the Krupp farms the "Oberharpener Mining Co." also owns a complex of grounds where 10,000 swine are kept continually to supply the employes of the company with meat and sausages.

The great net of waterways, spread over the whole of Holland, enables the Dutch to use peat fuel everywhere, owing to cheap water transportation. In countries with fewer waterways, Germany, for instance, the peat fuel is used at the place where produced, to drive large electric centrals, for electric light and power. These centrals, again, must not be too far from large cities, or a complex of villages, in need of cheap electric light or power. Two ways are followed in using peat to drive electric-centrals. First, peat is used directly for steam boiler firing, and generators are driven by steam engines or turbines. Secondly, generators are driven by gas engines of the explosive type, the gas being extracted from the peat fired in gas producers, and the by-products of this system, as ammonium sulphate, tar and tar water.

At Wiesmoor, Ostfriesland, province of Hannover, Prussia, large works using the first system are erected.

At Schwegermoor, near Osnabrück, province of Hannover, Prussia, is also a large electric-central on the peat deposit at that point, using peat producer gas.

The element which is lacking in peat from an agricultural point of view is potash, and the question of a potash supply for next year's peat soil must be taxing many of the minds of our agricultural peaters. How is this deficiency going to be made good? Your Editor would very much like to hear from those who have given the matter any consideration how they propose to overcome this difficulty; we would also like to obtain suggestions from our readers on this all-important subject.

Humus as an Aid to Stock Food*

The use of Peat, or Humus, as a stock food corrector and disease preventative, is, like the use of sweetened feed, comparatively new. It is not intended as a complete feed in itself but as a balance to a sweetened or mixed feed. In preparing the material for this purpose, it is subjected to a very high degree of heat, which practically makes it a charcoal and the most efficient absorbent known, and when mixed with other feeds, it will correct and counteract all harmful gases or acids. This is especially very essential in a sweetened feed, the base of which is molasses, which causes souring, belching and bloating; a reasonable percentage of humus will prevent this and will enable the manufacturer to use as high as 50 per cent. of molasses in his prepared feed, with just as much safety as the 15 or 20 per cent. usually used without humus. Humus will perform the same functions on green grass or ensilage feeds, or any other wholesome food that the digestive organs of the animal cannot assimilate by itself on account of its not being a balanced feed. The humus acts as a digester and makes it possible to force heavy feeding. To verify this we have the following from two large individual feeders and manufacturers of sweetened stock feeds:

"We use humus in all our mixed feeds for fattening purposes, also in connection with grass feeding and ensilage feeding, since doing this for some five years past, we find we can force feeding so as to get our meat stock on the market much earlier than we ever could before; we also find that we can use double the amount of molasses in our sweetened feed to what we ever could before using humus. It prevents any disorders to the animal's digestive organs and gives it a smooth coat. We would not think of feeding our stock in any manner whatever without a mixture of humus into such a feed."

"We have for the past four years been feeding our stock on a sweetened feed containing no grain whatever, of which the principal part is cotton seed product, molasses and humus. Since using your humus we can get more work out of our horses and mules and keep them in better order than we ever could before, in feeding them a grain feed. Cotton seed products and molasses as we use it could not be fed without humus. Our cattle and hogs are giving us better returns than we have ever had before. We feed and fatten entirely with the feed above described, and since using it have had practically no losses by disease. We have

*From Commercial Fertilizer.

for years been importing from Northern States young calves for breeding purposes but our losses in acclimating them were so great that we almost had to abandon the project. While we have had them vaccinated and under veterinary supervision, it was a losing venture. On your claim of humus preventing disease and seeing ourselves what it did with our native stock, we this season, in December, 1913, brought in here from Iowa 300 head of white face calves without vaccinating any of them. We put them on our feed above described and up to this time, July, 1914, we have not lost a single head. This is the most wonderful thing we have ever seen in our many years' experience in the cattle business and we attribute it all to the use of your humus. On the strength of this we are this year buying a large herd of Jersey calves from Pennsylvania and are going to feed them the same feed as we feel safe in your humus aiding us to acclimate them without any loss to us."

These two users of humus that we quote, the first in the corn belt and the other in the cotton belt, both now use several thousand tons of humus each, annually. An analysis of the ash shows that it contains liberal quantities of calcium and iron oxides, magnesia and phos. acid. all well known remedies for intestinal disorders. When the digestive organs of an animal are in good condition there is very little danger of contracting any of the diseases that domestic farm animals are subject to. We do not claim that humus will cure any disease but we do claim that any stock that is given free access to humus or fed it regularly, is not liable to contract any intestinal disease. It is claimed that hog cholera is a blood disease and can be cured or prevented only by vaccination or serum inoculation. We are not experts enough on hog cholera to say whether it is a blood disease or not, but we do maintain that if the intestines and the digestive organs of a hog are kept in a good healthy condition it will be able to throw off cholera and this can be done by regular feeding of humus. As we have said before, in preparing the material it is practically made into a charcoal and every one knows that charcoal is one of the best things that can be fed to hogs, as there is nothing that will sweeten the stomach quicker and with better results, and thereto is added the other elements that we mention, all of which we venture to say are worth more than any vaccination, etc. Besides feeding the hog or any other farm animal, including poultry, for its health, humus had a certain food value and is cheaper than any other feed that can be used in place thereof. Thus it will be seen by what we have said herein that peat is a great friend of the agriculturalist, it feeds his plants, renews his exhausted soil, it aids him in feeding his stock and prevents disease of all his domestic animals.

How to Prepare a Peat Bog for Fuel Making*

By Gust E. Carlsson, Farnham, Can.

After a suitable bog area has been procured, its preparation involves the following operations:

1. Surveying and examination of the bog.
2. Preparing a systematic plan for the work in general.
3. Draining.
4. Clearing and drying area.
5. Purchasing machinery.
6. Procuring and installing harvesting facilities, including track system, rolling stock, and storehouse.

The bog has to be surveyed and the material thoroughly examined in order to determine whether the requisite quality and quantity of peat exists. The deposit must be examined from the top to the bottom at numerous points to make sure that the development of the bog for the production of peat fuel is warranted.

A detailed working plan should be worked out so as to get the largest possible returns from the bog. The bogs are usually of different shape, size and depth, and each variant has an important bearing on how the work should be planned.

Draining is one of the most important features in preparing a bog, and the method adopted should be based on the character of the bog. For instance, if the peat making is to be done by hand, the bog should be drained clear to the bottom or below the level of that part of the peat you expect to utilize.

Hand-cut peat should not contain much more than 85 per cent. of moisture. However, if the peat is to be taken out with mechanical excavators, a moisture content of 90 per cent. is desirable, in order to allow a smooth and easy handling of the raw material from the working trench.

The ditches are of two, sometimes of three, different kinds and sizes, including the main ditch, the outlet from the bog, and ditches for the drying field. The main ditch should be made of a size and depth corresponding to the nature and depth of the bog, and also to the working method and machinery adopted. For each working trench a ditch has to be taken up deep enough to drain the bog sufficiently to carry the machine, and also take water from the ditches on the drying field. Ditches for the drying

*Read at the eighth annual meeting of the American Peat Society at Duluth, Minn., 1914.

field are of two different kinds, open and covered. Covered ditches are to be recommended. They cost about 25 per cent. more but they last twice as long as the open ditches.

The ditches on the drying field should be made at right angles to the working trench. The distance between these ditches is governed by the amount of water the bog contains, and also by the character of the surface of the bog, which often is of a highly absorbent nature. Both kinds of ditches for the drying field should be made 3 feet deep.

In clearing the surface of the drying area, it is necessary to bring the surface to a uniform level by removing the stumps, brush, trees, etc. The difficulties encountered in this work differ, because sometimes the bog is covered with big wood which has to be cut and the roots removed, so that the cost is considerable, and at the same time you can find a big field on the same bog that is as even as if it had already been prepared for a drying field. I may say that it is not enough to prepare only the field that is necessary for spreading the peat; all trees and bushes should be cut on an area at least 300 feet all around the drying field in order to give the sun and winds free play amongst the peat. The drying, which never can be too rapid, will thus be greatly expedited.

In deciding on or purchasing peat machinery the wisest and most economical thing to do is to buy and install machines that for years have proved successful. No chances should be taken with advertised machines that still are in the experimental stage.

For harvesting or collecting the dry peat from the field, it is most practical and convenient to have narrow-gage track laid out on the edge of the drying fields, parallel to the working trench and leading to the shipping station and also the storehouse. The cars or trucks are best hauled by a kerosene or gasoline locomotive. There is little danger of fire with such a locomotive.

I suggest that storehouses should be built large enough for two-thirds of the proposed entire output of peat.

Farnham, Quebec, August 12, 1914.

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EDITORIAL NOTES.

What Are the Members Doing? The present year has been one in which the members of the American Peat Society, with few exceptions, have evidently forgotten the Journal, and, perhaps, with just cause, as already noted. It should be remembered, however, that without authentic information, no news items regarding activities in the peat world can be published. The Editor has enough to do to put them in form for printing in the Journal, and he is entirely unable to devote the available moments at his command to searching for news or to sending out special letters asking correspondents to furnish it. If this is done, the editorial work suffers, as the time which should be given to it is all or in large part consumed in letter writing. Are there any in the Society, who will co-operate with the Editor by sending to him such peat news as comes to their notice? A few have done so in the recent past, but of late none of this helpful co-operation has manifested itself. Let every member of the American Peat Society who is doing any work on peat, or knows of any that is in progress, write about it to the Editor.

Oil in Peat Bogs. A correspondent in England reports that "some of the Irish peats are so oily that they are always spoken of as 'tallow peat' or 'fat peat,' which, to my mind, is caused by a large percentage of paraffin, naphtha, and wood tar or resin, present."

"In the North of Ireland, especially near Loch Neagh, County Antrim, where, no doubt, large forests of fir, spruce, pine, birch and oak were formerly abundant, it is a fact that the peasants collect the ancient wood from the peat beds and burn this as 'candles.' This seems to confirm the theory that there is a large quantity of turpentine or resin still free in the wood. I have in many places both in Scotland and Ireland picked out from the peat large lumps of this 'fat,' which, to my mind, was nothing more or less than resin, which has, no doubt, been in some cases converted into bitumen, and the oily streams we see in places on a bog are nothing more or less than water oozing through such beds of rotting wood as those mentioned, liberating their oils, which in turn flow to the surface.

"In Scotland in Aberdeenshire, I inspected a bog in which were large quantities of fallen timber. It is well known that in the year 1756 a violent gale of wind laid down many hundreds of acres of forest in the north of Scotland, and it was probably some such an occasion as this that caused the timber in other bogs to be laid low, and this fallen wood is now decomposing and thus liberating the oils.

"Some chemists state that the presence of petroleum in peat bogs is due to chemical action that is going on in the peat bogs themselves; but of this I know nothing personally."

PEAT AS A SOURCE OF ALCOHOL.

Within a few years there has been a revival of interest in a process by which ethyl or "grain" alcohol can be obtained from peat. It has long been known that cellulose could be broken down into sugar by proper chemical treatment, and that the sugar could be converted into alcohol by fermentation induced by yeast, as in the ordinary production of alcohol from cereals and fruits.

The revival of this process was reported from Denmark, Sweden, and France, where experimental factories were established to test the newly discovered yeast, and from them came the reports that alcohol could be made from the coarser and less decomposed types of peat, at a total cost of between 45 and 50 cents per gallon. Later accounts state that the Danish plant has closed indefinitely without commercial operation.

The process of making alcohol from peat, therefore, is still in an experimental stage. It may never reach the point where it will be used in this country, as in many communities apples and other fruits rich in sugar and sugar waste of various kinds are allowed to decay in large quantities when, for a smaller cost than peat can be used, they might be converted into alcohol for fuel uses.—C. A. Davis in Bureau of Mines. Bull. 16.

Abstracts, Patents, Etc.

Dr. Herbert Philip, Perth Amboy, N. J. Abstract Editor

PEAT IN THE MANUFACTURE OF PAPER.

By M. A.

(Translated from "La Papeterie Francaise," for Pulp and Paper Magazine, by C. E. Bandelin.)

The use of peat for paper manufacturing purposes was suggested long ago, and paper industry periodicals have many times published patents relating to this subject.

Canada is one of the papermaking countries most interested in the use of this raw material, as the area of peat bogs there exceeds 30,000,000 acres, or 10,000,000 more than in the United States, and more than any European country, except perhaps Russia. Many different methods have been suggested for utilizing the peat; as fuel, as gas producer, as raw material for the manufacturing of alcohol, as litter, as packing material for fruit. etc.

Previous experiments in using it for papermaking purposes, however, don't seem to have given very encouraging results from an economical standpoint, either with peat alone or mixed with wood pulp. The lack of success met with may be explained by several reasons. Several authors describe quite seriously digesting methods with soda or other chemicals under high pressure, sometimes followed by a bleaching with chloride of lime. The only result of such methods is the rapid vanishing of the capital engaged without any hope of future profits.

It must be remembered that the general term "peat" includes a great variety of vegetable substances, which have been submitted to a more or less advanced decomposition in the ground. It is evident that peat can give promising results or be immediately rejected, depending on whether it is of recent or old formation, or on which organic substance it contains. In this manner, it has been found impossible to utilize the peat from the vast bogs near Amiens (France) in any industry. Its state of decomposition is too advanced, and it crumbles to pieces when dry. Such peat, however, may be used as a fuel and give gas by dis-

tillation; perhaps it may have other uses, but not for papermaking.

Another kind of peat, however, occurring, for instance in the department of Basses-Pyrenees, France, has been experimented with and can certainly take a place among the raw materials for papermaking.

In most peat bogs there sometimes exists at a certain depth below the surface, 2-7 feet, a layer of only slightly decomposed peat, in which the constituent elements of the plants are found, only a little changed. Below this layer the peat is decomposed, darker, and cannot be used for papermaking purposes. In the experiments in question only the manufacture of cardboards was tried, as the peat seemed to be less suitable for paper manufacture, perhaps with exception for certain very dark-colored tar-papers.

The peat was used as it was taken from the bogs, without previous washing. It may be remarked, that it contained very little earth and extraneous matter. The washing of peat gives a very dirty, dark colored wash water, which cannot be let out into rivers or lakes, as this would cause complaints and difficulties.

The author simply refined the raw peat a little in order to cut off too long fibers, and to beat up certain somewhat coarse roots; he added digested straw pulp, about 50 per cent, and obtained a cardboard of an agreeable brown color, both strong and pliable. Its strength was certainly superior to cardboard made only of straw. He also obtained a satisfactory product by mixing 50 per cent of peat with 50 per cent of old paper.

The experiments were executed on a very small scale and no advices can be given as to results obtainable on a manufacturing scale. However, it seems as if the kind of peat used when only a little decomposed could very well be used for cardboards without any digesting. The screening surface, of course, must be large and continuously cleaned. The riffler also must be of ample dimensions.

It may be advisable to use the water passing through the wire over again, in order to have as little as possible to discharge in the river. The wire ought to be long and the speed slow on account of the high proportion of very short fibers, and also because some of the fibers possess a remarkable degree of "greasiness." The natural color of the peat does not permit manufacturing of light-colored boards, unless only a very small percentage is used.

From an economical point of view the use of peat under the stated conditions seems interesting on account of its cheapness. It is impossible to give a price for peat here, as it mainly depends upon local conditions. The mechanical extraction seems possible. but the problem is far from being solved for peat only a little de-

composed and still rich in fibers, which cannot very well be taken from the bogs by means of excavating machinery.

Extraction by hand is laborious and expensive. On the other side, if the peat is utilized on the spot, it is not necessary to dry it, but for transportation an air-drying is indispensable, as the percentage of water often reaches 95 per cent.

Notwithstanding all this, the peat is a raw material which the cardboard manufacturer in certain regions can obtain cheaply and which can be useful to him; mixed with straw pulp or old paper it will give, if sufficiently fibrous, cheap cardboards of good quality.

Peat Oils. (F. M. Perkin, J. Inst. Petroleum Technologists, 1914.) The destructive distillation of dry peat yields a thick tar containing paraffin wax, and an aqueous distillate containing ammonia, acetic acid, acetone, and methyl alcohol. The gases evolved are sufficient to carbonize the peat if it has been previously dried till it contains only 20 per cent water. Coke hard enough for metallurgical purposes is obtained from suitably dried briquetted peat. The tar is fractionated finally with superheated steam, to prevent carbonization, and the fractions are washed with alkali and acid. The oils are largelv paraffinoid. The yield from a briquetted Yorkshire peat was 38 gallons per ton, giving on fractionation 1.35 per cent of oil of sp. gr. 0.867 below 150° C., 29-30 per cent of sp. gr. 0.953 below 250° C., 50.00 per cent of sp. gr. 0.941 above 250° C., and a residue of hard pitch. The last fraction contained 6 per cent of paraffin wax. From 11 to 22 pounds of ammonium sulphate per ton was also obtained. The cost of dried peat should not exceed 54 cents per ton and, on this basis, the production of oil and carbon should be remunerative. Details of a plant to treat 50 tons of wet peat per day show that the capital required is $15,000 and the labor charges $3,600 for 6 months. Labor charges would be lower for a larger plant. (Through J. Soc. Chem. Ind..)

Peat in Italy. According to a recent issue of the "Monitore Tecnico," two bogs in the regions of Mantua and Ferrara have been drained, and it has become possible to work below sea-level. One of the bogs is 1,730 and the other 1,235 acres in extent. The thickness of the bed of peat varies from 1 foot 8 inches to 3 feet 3 inches. After being dried, the peat is carbonized in six retorts, the capacity of each being 30 metric tons per 24 hours, with a dailv production of about a million cubic feet of gas having a heating value of 155 B. t. u. per cubic feet. At the same time 120 quintals of sulphate of ammonia are obtained. There are also adjoining works for the manufacture of the sulphuric

acid required for making the sulphate. Large quantities of tar are also produced. The works cover an area of 22 acres. The results are stated to have been satisfactory, from both the technical and the financial point of view.

In the plants at Orentano and Codigoro, the Jour. of the Roy. Soc. of Arts reports that artificially dried peat, containing 25 per cent of water, is carbonized in a turret-shaped oven 26 to 33 feet high, by the Mond process. From one metric ton (2,240 pounds) of peat containing 2.5 per cent N about 175 pounds of ammonium sulphate are thus obtained at a cost of from $1.16 to $1.34 per cwt. (112 pounds). The factory at Orentano has been working since 1910, the present daily capacity being 1,800 cubic feet of peat, yielding 50 tons of ammonium sulphate per month; at the works at Codigoro, operated since 1912, 150 tons of dried peat, yielding 10 to 12 tons of ammonium sulphate, are treated daily.

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The Production of Peat in 1914*

By Charles A. Davis

INTRODUCTION.

Peat is incipient coal. It is made up of the more or less thoroughly decomposed and carbonized remains of plants accumulated under conditions that have prevented their complete transformation into gaseous and mineral matter. In the course of their growth plants segregate carbon dioxide from the gases of the atmosphere and, by the aid of sunlight, decompose it and water in their green tissues and recombine the elements into complicated organic compounds, in which carbon is the characterizing element. If the compounds formed in this way by practically all green plants decay in the air, they are slowly changed back to gases again, chiefly by the activities of plants and animals of low orders, the biochemical agents of decomposition. If, however, the air is excluded from accumulations of plant material, chemical and physical changes of quite a different character take place—and much more slowly than when air is present—by which the vegetable matter loses only a part of its constituents. In the course of such changes and losses two gases—hydrogen and oxygen, the chemical elements that form water—disappear more quickly than carbon, the third important chemical element, which in combination with them forms cellulose and lignin, the compounds of which most plant tissues and organs are composed. The carbon is concentrated as such changes continue, and the original plant material becomes more and more nearly pure carbon. Peat, lignite, coal, anthracite, and graphite, a form of carbon, are successive stages in this process of carbonization as it is represented in nature. Similar changes are made in wood or other plant structures when they are heated in closed vessels, the residue left after heating being charcoal, also a form of nearly pure carbon.

*From U. S. Geological Survey.

Conditions Under Which Peat Occurs.

The chief agency by which vegetable matter is preserved from the attacks of air-requiring organisms is water. Peat, therefore, is found—if other conditions permit the growth of vegetation—in lakes, swamps, marshes, bogs, and other perennially wet places. Such places are found where the land surface contains many depressions and poorly drained plains, where the temperatures of air and soil are low in summer and the humidity of the air is high, and where precipitation exceeds run-off and evaporation combined.

Distribution of Peat In the United States.

In the United States the regions most favorable for the occurrence of deposits of peat are in the States lying east of about the nineteenth meridian and north of an irregular line following the southern margin of the last or Wisconsin glacial drift. This line runs nearly due east across north-central Iowa, Illinois, Indiana, and Ohio, and, after dipping southward a short distance along the Appalachians, turns northeastward across Pennsylvania and New Jersey nearly to the coast. Peat deposits are also of frequent occurrence in the region extending southward from New Jersey along the Coastal Plain to and including Florida. In the regions of heavy rainfall along the Pacific coast peat deposits occur wherever the drainage is sufficiently interrupted to allow the soil to be flooded or permanently saturated by water.

The States known to have the most extensive peat deposits are Florida and those along the northern border as far west as North Dakota. These States, with the exception of Michigan and Ohio, have no known coal deposits and, on account of climatic and industrial conditions, are extensive consumers of fuel, a constantly increasing percentage of which has to be imported by rail and water.

Uses of Peat In Europe—Peat as Fuel—Pressing Water from Peat.

The most serious difficulty in producing peat fuel on a large commercial scale is the necessity of eliminating from the raw material the large percentage of water it contains. This may constitute considerably more than 90 per cent of the weight of the peat in an undrained deposit and is seldom less than 85 per cent in well-drained bogs. This water, because of the mechanical structure of the partly decomposed vegetable matter with which it is associated and the peculiar chemical compounds of which it forms a part, cannot be cheaply and quickly pressed out of the peat even by the use of great mechanical force. The mechanical extraction of water from peat has been attempted by inventors and students of peat problems for more than 50 years. Many types of presses have been used, but with no practical success.

Raw Peat.

For centuries peat has been extensively used for domestic fuel by the peasantry of northern Europe. It has long been the custom there to cut the peat from carefully drained deposits in brick-shaped blocks by means of specially shaped spades and knives and to dry these blocks by exposure to the heat of the sun and air during the short summers. More recently the quantity of peat mined has been increased, and the quality, and therefore the efficiency, of the fuel produced has been greatly improved, so that it can be used to produce power. These results have been attained by the improvement of the machinery for digging and grinding the raw peat, for shaping it into blocks of convenient size, and for spreading out the blocks thus formed to dry on the surface of the bog or on special drying grounds. By far the greater part of the peat fuel used in Europe is produced by some modification of this process of air drying the wet peat. Fuel thus prepared is called "machine peat."

Briquetted Peat.

Peat is also prepared for fuel by partly air drying it and reducing it to powder. The partly dried powder is then artificially dried to a fixed moisture content and is pressed into briquets of uniform size, shape, density, and weight by a powerful press of special form, called a briquetting press.

Briquetting has proved highly successful in various European countries for increasing the compactness and fuel efficiency of coal fines and of lignite, but for several reasons it has never been wholly satisfactory for peat. The most recent information available from Europe indicates that after many commercial trials, extending over at least a quarter of a century, there was but a single peat-briquetting plant in operation in Europe in 1913. This plant produced only a very small part of the estimated output of that year of more than 15,000,000 metric tons.

Powdered Peat.

Powdered peat is made ready for use as fuel by crushing and grinding machine peat blocks after they have been dried down to about 35 or 40 per cent moisture by exposure to sun and wind. The crude powder thus obtained is screened and then heated in rotary driers until the peat contains only about 15 per cent of moisture. After this treatment the powder may be used for firing steam boilers by burning it in blast burners of a design suitable to give the most complete and efficient combustion. Good peat thus treated is reported to give nearly as much energy in the form of live steam as the same weight of good English coal, and in Sweden, where the tests were conducted, at a less cost per ton of fuel.

The production and use of powdered peat for fuel are still in the experimental stage, but, if the reports of officially conducted tests are to be relied on, have very considerable possibili-

ties, not only for boiler firing but for metallurgical work, such as smelting and refining, and also for use in cement and other kinds of kilns, such as have already been successfully fired by burning powdered coal.

Peat Charcoal or Coke.

When peat is heated in covered heaps or in closed ovens or retorts of iron or masonry, gaseous, liquid, and tarry volatile substances are driven off by the heat. The greater part of the carbon and all the mineral matter of the organic compounds of the peat are left behind as charcoal or coke. The so-called coke obtained from peat is, in reality, only a charcoal, as there is no such fusion of particles by the action of heat as takes place in the coking of coal.

The manufacture of peat coke is expensive unless the volatile matter driven off from the peat can be recovered and used or made into salable products, because only about one-third of the original weight of the peat used is recoverable as coke of the best grade. It is possible to recover this volatile matter, and for more than 60 years experimenters have attempted to utilize in commercial plants the methods used in recovering chemical by-products in plants for the distillation of wood. Many of these attempts have resulted only in technical success, and few such plants have been commercially profitable to their owners.

The chemical by-products to be obtained by distillation of peat are practically the same as those yielded by wood, but in different proportions. Only those having the highest market value and recoverable in the largest percentages are recovered in practice, unless the plants are of unusually large size. The volatile substances driven off during the coking process are converted into gases. The lightest of these compounds do not condense on cooling, and they contain so large a percentage of combustible matter that they can be burned to keep up the heat necessary to carry on distillation. In order to separate such gases from the condensable portions of the distillate they are passed through cooling and washing chambers, in which the less volatile gases are condensed into liquids.

These liquids are of varying density and weight and readily separate by gravity into the heavy, tarry liquids and the lighter watery ones, the tars remaining at the bottom of the condensing chambers and the light, watery solutions rising to the top, whence they may be drawn off. From such solutions the valuable chemical compounds which they contain may be recovered and purified by distillation, by crystallization, or by precipitation in insoluble form, and filtration.

From the watery compounds may be had methyl or wood alcohol, acetic acid or some of its derivatives, and ammonia. Ammonia is the most valuable substance thus obtained. It is usually recovered as ammonium sulphate, a very important constituent of commercial fertilizers. In practice it is usually the only by-product considered worth recovering from the tar water.

The tarry constituents of the distillates may be separated into a variety of compounds of greater or less commercial value by redistillation. In practice, illuminating and lubricating oils and paraffin wax may thus be easily obtained. The heavy tars left after distillation are asphalt-like substances and may be employed for some of the same uses as asphalt. Another way of utilizing the tars is to saponify them and to use the product as lubricator for wheels of cars and heavy trucks.

The charcoal derived from well-macerated peat in the form of thoroughly dried blocks is hard and tough, and it sustains greater crushing force than the best hardwood charcoal. It contains very low percentages of sulphur and phosphorus and is, therefore, valuable for metallurgical work. Nearly all the peat coke produced in Europe is used in refining metals and in producing the highest grades of steel. The latest reports from European countries indicate that two plants making peat coke are in operation and that they recover the by-products.

Wet Carbonization of Peat.

Some years ago Ekenberg, a Swedish chemist, announced that he had discovered that by heating raw peat under a pressure of 10 atmospheres to a temperature of about 170° C., the colloidal compound which holds the water in the peat, and which he identified as hydrocellulose, is destroyed. After this heating the water can be quickly and cheaply pressed from the cooked peat and the residue be compressed into firm, very dense briquets, which, on further drying, make excellent fuel. By this process, which was called wet carbonizing by Ekenberg, the peat was blackened and, according to published reports, lost weight, the loss being accompanied by the evolution of heat and gases. Ekenberg died without making his process commercial, but, after several years of experimentation, the company controlling the patents on the process announced the completion of a successful mechanical plant capable of converting raw peat of the best quality into wet-carbonized peat fuel, which, it was claimed, equaled high-grade coal in fuel alone. Such plants were being built in at least two European countries in the summer of 1914, when the breaking out of the war caused a total suspension of operations.

The objection to this and to all other processes requiring the repeated handling of large volumes of raw peat by expensive machinery, is that each additional operation adds disproportionately to the costs to be charged against the finished product, because the large quantities of water it contains are handled at a loss, a loss that must be paid out of the selling price of the fuel. The selling price, however, is largely fixed by the market price of coal, which is comparatively stable and low. Therefore, the simpler the process of producing a salable fuel the more likely it is to be financially successful.

Producer Gas from Peat.

Peat consumed in any properly designed gas producer yields producer gas good in quality and abundant in quantity in comparison with the yield from coal. This seems to be the most effective way to use peat fuel for generation of power, because fuel so used does not need as careful preparation nor as thorough drying as when it is to be used under steam boilers. The gas producers can be located at the bogs and the gas generated can be converted into electric energy by the use of gas engines and transmitted to centers of consumption more cheaply than the fuel can be transported. If this procedure does not seem desirable, the producer gas can be piped long distances and used for firing steam boilers, for metallurgical work, for firing kilns, or in gas engines, by means of which the highest efficiency in the use of any given fuel can be attained.

Several European manufacturers of gas producers have developed gas-producer plants for using peat fuel that have been in commercial operation long enough to demonstrate their practical value. Such plants have been used successfully in England, Ireland, Germany, Sweden, and Russia for the generation of electricity for light and power and also to furnish power directly for various manufacturing industries.

By-Product Gas Producers.

Peat, in comparison with coal and lignite, contains a large percentage of combined nitrogen in the form of decomposable organic compounds. In much peat this nitrogen exceeds 1.5 per cent of the dry weight of the peat, and in some it is as much as 2.5 or 3 per cent, or in the proportion of 50 to 60 pounds to the ton.

In the early stages of gasification of fuels in gas producers the more volatile substances are given off in large volume from the less strongly heated parts of the fuel. Among these substances is the ammonia generated by the decomposition of the nitrogen compounds. If the ammonia thus liberated is heated too hot, however, it is in turn decomposed into its constituent elements and is lost. By keeping the fuel bed in the gas producer at temperatures so low that the ammonia is not destroyed and yet high enough to decompose the rest of the fuel into burnable gases, at least 75 per cent of the ammonia may be separated from other gases during the purifying process or scrubbing necessary to prepare producer gas for use in gas engines and may be fixed in permanent compounds. The fuel bed is kept at the low temperature necessary for getting a large yield of ammonia by the introduction of steam at proper intervals and the ammonia is made to combine with sulphuric acid by bringing the gases with which it is mixed into contact with the acid in the form of a fine spray. The ammonium sulphate thus formed passes into the solution in tanks or receptacles provided for the purpose, from which at intervals it is drawn off, crystalized, filtered, and purified. By-product gas producers are used

only in plants in which 2,000 or more horsepower is to be generated, because the returns in ammonia are too small to be remunerative in smaller plants.

Other chemical compounds of value, including tar of good quality, may be recovered in purifying producer gas, but, as in peat-coking plants, the chief by-product sought is the ammonia. The tar is next in value, where a market can be found for it.

The process of recovering ammonia from gas producers using bituminous coal was first developed by Sir Ludwig Mond, in England, and later was extended by the company controlling his patents to the gasification of peat. There are now in operation in England, Germany, and Italy large gas-producer power plants that use peat fuel exclusively and that are reported to pay all operating expenses from the sale of sulphate of ammonia recovered as a by-product, thus obtaining free the gas and the power generated by its use. One plant of this type in Italy makes no use of the gas generated beyond supplying its own requirements for power and heat, but depends entirely on the ammonia recovered for its profits. The statement has frequently been made that peat containing 1.5 per cent or more of nitrogen will yield a good profit from the ammonia which may be recovered by this method of gasification.

Peat as a Source of Ammonia.

Peat beds are therefore important potential sources of the most costly ingredient of modern chemical fertilizers, sulphate of ammonia. As the peats of the United States show, from carefully made analyses, that they are very rich in combined nitrogen, in comparison with the peats of Europe, many of them exceeding 2 per cent and some containing more than 3 per cent of the total dry weight, it would seem that a highly profitable industry could be based on them, especially when the value of the power gas to be derived from the same sources is taken into consideration.

Peat as Stable Litter.

During the last few years the lighter and more poorly decomposed kinds of peat, especially that originating from sphagnum moss, has been produced in Europe in rapidly increasing quantity for use as stable bedding for horses, cattle, poultry, and other domestic and farm animals. The method of preparing peat for such use is very simple and requires but small outlay for machinery and plant. The bog is drained, and the upper fibrous layers of peat are cut into blocks, which are laid out to dry on the surface of the bog. When partly dry the blocks are piled in small open stacks for further drying, after which they are stored in large piles until used. The only other treatment given to the raw material thus obtained is to shred the blocks into small pieces by passing them through some form of disintegrating machinery and to remove sticks and other hard foreign matter. The shredded material is then screened and the

coarse fragments are baled and sold for stable litter and the finer residue is sold under the name of peat mull, which has a variety of uses, such as for packing fruits and vegetables for shipment, as an absorbent and deodorizer, and for disinfection.

Peat litter, prepared as described, is very absorbent and is much cheaper, more durable, and more satisfactory in every way than straw, shavings, or any of the materials commonly used in the United States for stock bedding. The production of this material, although greatly increasing abroad, has not been attempted in this country for some years past, but as it can easily be prepared for market by inexpensive machinery there is among the possible ways for using peat no more tempting field for investment.

Peat as Food for Stock.

The peat mull obtained by screening the peat shredded for stable litter has long been used in Europe as the basis of food for stock made by mixing it with refuse molasses, obtainable in large quantities at a low price from beet sugar factories and cane sugar refineries. This material makes excellent and fattening food, but is difficult to feed to stock on account of its stickiness and fluidity as well as because of its effects on the digestive organs. When mixed in proper proportions with peat powder, however, it is readily eaten by all kinds of live stock, and beef cattle, hogs, sheep and horses are reported to be greatly improved in condition and weight by its use. In England, Sweden, and Germany, thousands of tons of peat mull are used annually in the preparation of such sweetened cattle foods, but until recently, possibly on account of the lack of an available supply of peat in the proper form, it has had very slight use in the United States. For the last few years, however, an increasing quantity of mixed stock food containing molasses has been manufactured and sold in this country, and still more recently, powdered black peat has been added to mixed cattle foods in small quantities with reported beneficial effects.

Peat Fiber.

In certain localities fine, tough, fibrous masses of sedge remains are obtained from sphagnum peat while the peat is being shredded for making litter. Such fiber, after thorough cleansing by beating and washing, is used either alone or mixed with other fibers, for making fabrics, for paper stock, for insulating material, especially in refrigerating plants, and for filling mattresses and stuffing furniture.

Utilization of Peat In the United States.

In spite of the facts that peat has so many uses in European countries and that the peat deposits of the United States are very extensive, the domestic material has only recently been produced on a commercial scale for any purpose.

Peat as Fuel.

Many attempts have been made in this country to manufacture peat fuel, with almost uniform lack of success. The reasons for failure of such enterprises have been manifold, but so far as can be determined by careful inquiry the failure was not caused by inability to sell the product after it was made, but generally by other factors, among which may be mentioned inexperience of operators, impractical machinery, and lack of sufficient capital to carry the plant over critical periods.

In 1914, so far as reported, there were four peat-fuel plants in operation in the entire country, with an estimated production of 1,925 tons of air-dried machine peat. Of these plants, one had been operated more or less regularly for several years, but on a small scale, employing but three men during the working season of 1914. A second plant was wholly experimental and was in operation only occasionally. One of the other plants was not completed until late in the season, and consequently was in operation only a short time and with an unskilled force. The fourth plant reported a prosperous and satisfactory season.

The outbreak of the war in Europe caused an entire suspension of plans for development of large plants for using peat fuel in Florida and Georgia. To the same cause may doubtless be attributed the closing of two very promising peat-fuel factories in Canada before the end of the season.

Peat as Fertilizer and Fertilizer Filler.

The most successful industry based on peat so far attempted in the United States is that of preparing peat for use as a fertilizer or as a filler for chemical fertilizers. Black, thoroughly decomposed peat is most satisfactory for all fertilizer uses, as such peats are generally heavier, more compact, and contain more nitrogen and less fibrous material than the brown types.

The processes of preparing peat for such uses are comparatively simple. The bog is drained thoroughly, and the surface layers are carefully plowed and cultivated for one or more seasons before digging begins. The peat is prepared for sale by reducing it to the state of a powder containing about 10 per cent of moisture. When an area is considered ready for gathering the peat the surface is repeatedly harrowed either by ordinary harrows or by special machinery for the purpose of drying the surface layers as much as possible. When sufficiently dry the harrowed peat is scraped into windrows and loaded on train cars, which, in the larger plants, are drawn to the drying plant by small locomotives operated by electricity or gasoline. The unloading is done from a trestle over the stock pile, from which the peat is elevated as needed to the inlet hoppers of large rotary cylindrical driers. The driers used are of the directly heated single-tube type—that is, they consist of a single shell of boiler iron, with a large furnace at one end and a settling chamber, from which the smokestack or chimney rises, at the other. The

cylinder is slightly inclined from the inlet to the outlet end and is revolved on its long axis by mechanical means. Iron flanges, running spirally the length of the inside of the cylinder, raise the peat to the top of the tube and drop it to the bottom through the heated air and gases, as these pass from furnace to smoke-stack, and at the same time move it steadily forward to the outlet, where it is automatically discharged. Usually a fan blower or an exhaust fan increases the draft through the drier, and this can be regulated to meet the requirements of the peat. After the peat has passed through the drier it is elevated by mechanical conveyers of considerable length to permit proper cooling, screened to remove coarse and lumpy material that has not been completely disintegrated in drying, and immediately shipped or stored in fireproof storage bins.

The peat that is prepared for fertilizer filler, for stock food, and for certain grades of fertilizers of which the peat powder forms the base is dried to a moisture content of about 10 per cent. When the peat is to be applied directly to the soil as a source of humus and of organic nitrogen, the drying is not carried so far. Considerable quantities of peat are prepared for such use and are sold as "sun-dried," and in that state the material may have a moisture content of 25 to 50 per cent or even more.

Some of the peat sold during 1914 for direct use as fertilizer was enriched by the addition of mineral salts of high fertilizing value, especially compounds of potassium and phosphorus and substances furnishing organic nitrogen to supplement that present in the peat.

The production of peat for fertilizer uses during 1914 as reported was 37,729 short tons, valued at $249,899. The selling prices given varied widely according to the grade of the product, the uses to which it was to be put, the quantity and quality of materials added, and the size of the selling unit. In carload lots the price of sun-dried, untreated peat ranged from $3.50 to $6 a ton. In small lots, shipped in bags or barrels, the prices ran considerably higher. Fertilizer filler, sold at a somewhat uniform price per unit of nitrogen, varied according to the percentage of nitrogen and locality of production from $4.50 to $7.50 a short ton, the average price being $6.02. The quantity of peat sold for fertilizer filler was 22,267 tons and for fertilizer 14,962 tons.

Miscellaneous Uses of Peat in 1914.

Three other uses of peat were reported by producers in 1914—for stock food, for mud baths, and for making paper. As the production for each use was reported by a single firm, the whole output is given under a single heading. This total was 7,439 short tons, valued at $53,253. The highest price and the lowest production reported for any peat product was that of peat for paper pulp, as the plant producing it was in operation only a small part of the year.

Food for Stock.—The largest quantity of peat reported sold for other than fertilizer uses was sold for use in mixed stock foods containing molasses. The single producer who reported sales for this purpose stated that the results obtained by the use of peat in such foods have proved very satisfactory in practice, the peat acting as a tonic and a corrective. The kind of peat so far used in this country for the purpose is of the black, well-humified type. The method of preparing it is practically the same as for fertilizer filler.

Mud Baths.—At several of the famous health resorts of Germany and Austria mud or peat baths have long been used with great success, and during the last few years such baths have been tried in some of the sanitariums of the Middle West and found beneficial in certain cases. Well-decomposed peat, free from coarse or woody material, is the basis of the mixtures used, and the demand for grades of peat suitable for this use is reported to be increasing.

Peat Litter In the United States.

As noted above, no peat litter has been produced in this country for several years. As in previous years, however, a certain quantity was imported into New York City and other coast cities in 1914 from Holland and Germany under the name "peat moss." The entire importation was 8,858 long tons (9,921 short tons), valued at $57,542, or at $5.80 a short ton. No attempt was made to produce this material at home, so far as could be learned.

Production of Peat In 1913 and 1914.

During 1914 no new processes or machinery for preparing peat for fuel were reported to have been given commercial trials in the United States. The whole number of plants reporting production was 14, of which 10 sold peat for fertilizer uses. Two firms that furnished data for 1913 did not co-operate for 1914, and four firms are represented for the first time, having made their initial production during the year.

The 14 plants known to be at work during the year were distributed as follows: Maine, 1; Massachusetts, 1; Connecticut, 2; New York, 1; New Jersey, 3; Pennsylvania, 1; Florida, 1; Michigan, 2; Illinois, 1; Indiana, 1.

The following tables give the quantity of peat products made and used in the United States in 1913 and 1914, so far as these have been reported:

Production, Imports and Consumption of Peat in the United States in 1913, in Short Tons.

Use.	Production. Quantity.	Production. Value.	Imports. Quantity.	Imports. Value.	Consumption. Quantity.	Consumption. Value.
Fertilizer	28,460	$169,600	......	....	28,460	$169,600
Stock food	4,800	27,600	......	....	4,800	27,600
Stable litter	......	....	10,983	$55,719	10,983	55,719
Total	33,260	197,200	10,983	55,719	44,243	252,919

Production, Imports, and Consumption of Peat in the United States in 1914, in Short Tons.

Use.	Production. Quantity.	Production. Value.	Imports. Quantity.	Imports. Value.	Consumption. Quantity.	Consumption. Value.
Fertilizer filler	22,767	$136,994	.....	....	22,767	$136,994
Fertilizer	14,962	112,905	.....	....	14,962	112,905
Fuel	1,925	6,540	.....	....	1,925	6,540
*Miscellaneous	7,439	53,253	.....	....	7,439	53,253
Peat moss litter....	......	....	9,921	$57,542	9,921	57,542
Total	47,093	309,692	9,921	57,542	57,014	367,234

*Only 1 producer each of peat for stock food, mud baths, and paper pulp.

PROCEEDINGS OF THE NINTH ANNUAL CONVENTION OF THE AMERICAN PEAT SOCIETY, DETROIT, MICH., SEPTEMBER 20, 21, AND 22, 1915---THE MEETINGS WERE HELD AT THE HOTEL STATLER

Morning Session, September 20.—The President, Mr. Carl G. Kleinstueck, on taking the chair, announced receipt of a telegram from the Secretary, Mr. Julius Bordollo, stating that owing to illness he would be unable to be present at the meetings.

Mr. Arthur J. Forward, of Ottawa, Canada, Secretary of the Canadian Peat Society, and a member of the American Peat Society, was nominated and elected Secretary pro tem. to act during the convention.

Mr. Barrett, Secretary of the Convention Bureau of Detroit, on behalf of that organization, gave a brief address welcoming the members of the American Peat Society to the city, and outlined the various attractions which the city offered to visitors, and the special arrangements made in conjunction with the Detroit Committee on Arrangements, headed by Prof. W. H. Allen, of the Chemical Department, Detroit Y. M. C. A., for the entertainment of the Society during their stay in the city. He commented especially on the fact that the influence of the Society's meetings would not be confined to those in attendance, but that through publication of its proceedings the Society reached a large number of readers throughout the United States, who were deeply interested in the development of peat lands.

Mr. Barrett said that the educational campaign in the Detroit press, in connection with the holding of the convention in that city, had aroused much local interest in peat, and that he felt sure that the deliberations of the Society would be productive of important results.

The thanks of the Society to the Convention Bureau and to the Detroit committee for the welcome extended and for the efforts made by the committee, were fittingly expressed by the President.

Owing to the absence of the Secretary the financial report for the year was not dealt with.

Prof. Charles A. Davis made a brief statement with regard to the publication of the Journal of the Society, saying that an editorial committee had been recently formed with a view to better division of the work entailed in the preparation of the Journal, and to increased efficiency, and said that it was hoped that as a result the Journal would in future appear more regularly than in the past. Professor Davis made a strong appeal to the members present to aid the committee by supplying papers

on subjects of interest and other matter for the Journal, and to assist individually in advancing the interests of the Society.

A paper on "The Agricultural Utilization of Muck Lands" was read by Mr. C. S. Robinson, of the Michigan Agricultural College Experimental Station, at East Lansing.

Mr. L. A. Krupp, of Findlay, O., read a paper on "The Why and How of Draining Peat Lands."

Afternoon Session.—At the opening of the afternoon session the President was authorized to send a telegram to Mr. Bordollo, expressing the regret of the members of the Society at his absence.

Prof. Charles A. Davis read a paper on "Utilization of Peat in the United States."

A paper on the "Agricultural Possibilities of the Peat Soils of Ohio," prepared by Dr. Dachnowski, of the United States Bureau of Plant Industry, was, in the absence of the writer, then read by Prof. Davis.

Prof. F. J. Alway, of University Farm, Minn., read a paper on "The Present State of Experimental Agriculture on Peat Lands in Minnesota." Prof. Alway's paper was well illustrated by a series of illuminative charts which had been specially prepared, and also by a well-arranged display of samples of grains and grasses grown in the course of the experimental work described.

Evening Session.—The evening session was opened by an address by the President, Mr. Carl G. Kleinstueck, who took as his theme, "Our Marshes."

Prof. Patten addressed the Society on "The Peat Soils of Michigan and Their Value in Agriculture."

Mr. Robert Ranson, of Pablo Beach, Fla., addressed the meeting at the request of the President.

Prof. Allen announced that at the close of evening meeting of the following day, arrangements had been made for the entertainment of the members of the Society at a smoker in the convention hall, and that a number of Detroit chemists would be present.

Morning Session, September 21.—At the opening of the session the President announced that an automobile ride had been arranged, leaving the hotel at 1:30 p. m., to see in operation in the outskirts of the city a new Buckeye traction ditcher.

The following committees were appointed:

Nominating Committee:—Prof. Charles A. Davis, Mr. E. V. Moore, Dr. C. S. Robinson.

Committee on Resolutions:—Mr. John Wiedmer, Mr. Paul Todd, Prof. F. J. Alway.

A paper was then read by Mr. B. F. Haanel, chief of the fuel-testing division, Mines Branch, Department of Mines, Canada, on "The Value of Peat Fuel as Compared With Coal for Power-Gas Production."

Mr. Ernest V. Moore, of Petersborough, Canada, addressed the meeting, and gave a full description of the operating peat fuel plant erected and operated under his supervision at Alfred, Ontario.

At 1:30 p. m. automobiles were in waiting at the hotel entrance, and the members, conducted by Messrs. L. A. Krupp, W. A. McGoon, and W. L. Dillon, were driven to a suburban property where some time was spent in witnessing the operation of a Buckeye traction ditcher in sewer construction.

Evening Session.—At the opening of the evening session Mr. Otto I. Bergh, of University Farm, Minn., showed lantern slides and specimens illustrating the work done in growing various farm crops at the Grand Rapids, Minn., Experiment Station, of the University of Minnesota, accompanying them with apt explanations.

A paper was then read by Mr. John Wiedmer on "The Use of Peat in Stock Foods."

A number of members of the Detroit Chemists' Society were in attendance at the evening session, and at its close a very pleasant entertainment provided for the Peat Society under the efficient direction of Prof. Allen was enjoyed. Cigars and light refreshments were provided, and the proceedings took the form of a most enjoyable social gathering to which much interest was added by an exhibition of moving pictures illustrating industrial processes, with occasionally films of lighter character interspersed. The meeting broke up shortly after 11, all agreeing that a charming and profitable entertainment had been afforded the members by the committee.

Morning Session, September 22.—Mr. Kleinstueck: Mr. Paul Todd will favor us with his paper on "The Care and Cultivation of Peat Lands." I am constantly in receipt of a great many letters asking advice as to the cultivation of marsh lands. It seems to me it would be a good move for the Society to issue a small pamphlet on the subject. If sold at a small price, say at 25 cents each, such a publication might be profitable. And I further suggest that, in my opinion, Mr. Paul Todd is the best man on the continent to write such a pamphlet.

Mr. Paul Todd read the paper announced.

Owing to the near approach of the close of the meetings and the ground yet to be covered there was no discussion of Mr. Todd's paper.

B. von Herff addressed the Society with regard to the potash supply, stating that he had been for 25 years with the Potash Syndicate. Other important details mentioned were as follows: The potash supplies of Germany are very extensive and for practical purposes inexhaustible. The bulk of the German potash, which is found in many localities, is derived from Kalolith, which contains 9 per cent potash. Wood ashes were formerly the source of a considerable amount of potash, but the supply from this source has become very much diminished. Tobacco stems are capable of supplying some potash, and from

the refuse of sugar beet manufactories about 2,000 tons is produced. A number of processes have been discovered for the manufacture of potash from feldspar, but they are, so far, too expensive to be of practical importance. A considerable deposit of alunite in Utah is available, and efforts are being made to produce potash commercially from the great kelp beds of the Pacific Coast.

A paper on "The Value of Humus in Soils," by Prof. H. C. Thompson, was read by Mr. E. V. Moore.

A statement with regard to the agreement between the American Peat Society and the Bureau of Plant Industry was made by Prof. Davis. When the agreement was made it was thought that there were peat owners who would allow experiments to be carried out on their lands, but difficulty has been experienced in finding owners who would give the use of sufficient ground for the purpose. The committee having the matter in hand still need offers of sufficient acreage to be turned over to the Bureau of Plant Industry for the conducting of experiments covering a series of years.

The report of the Committee on Nominations was presented by Prof. Davis, and recommended that the officers of the Society for the preceding year be renominated.

Mr. Wiedmer moved, seconded by Mr. Bergh, that the report be received and accepted, and that the Secretary be instructed to cast a vote by ballot for the re-election of the present officers.

The motion was unanimously carried, whereupon the Secretary cast a ballot as directed, and the President announced that the officers for the past year were reelected for the ensuing year.

The report of the Committee on Resolutions was presented by the Chairman, Mr. Wiedmer. The committee made the following recommendations:

1. That the Society express its appreciation of the excellent manner in which preliminary arrangements had been made by the Detroit Committee of Arrangements, and by the Convention Bureau of the city as represented by its Secretary, Mr. Barrett.

2. That there be conveyed to Mr. W. F. Bergman, manager of the Hotel Statler, the thanks of the Society for his thoughtfulness in providing the Society with such a highly satisfactory room in which to hold its sessions, and for his hospitality.

3. That the Society express its appreciation of the courtesy of the Buckeye Traction Ditcher Co., of Findlay, Ohio, and of Messrs. W. A. McGoon and W. L. Dillon, to whom it is indebted for the personally conducted automobile trip of the preceding afternoon.

4. That the thanks of the Society be conveyed to Mr. Schmidt and to Prof. Allen for the delightful entertainment of the preceding evening.

5. That the Society, while regretting that the unfavorable

weather conditions prevented the excursion to London, extend its thanks to Dr. McWilliam for his kind invitation.

6. That the Society acknowledge the great loss that it feels in the death of its past President, Dr. J. A. Holmes, Director of the United States Bureau of Mines, who, from its inception, has proven one of its staunchest friends and wisest counselors.

7. That the thanks of the Society be expressed to Mr. Arthur J. Forward, for so ably acting as Secretary pro tem in place of Secretary Bordollo, absent on account of illness.

It was moved by Mr. Arnold, seconded by Mr. Bergh, that the report be accepted and that the Secretary be authorized to transmit the resolutions to those concerned. Carried unanimously.

The President read to the meeting invitations received from Chicago, Buffalo, St. Augustine, Fla., and Grand Rapids, Mich., inviting the Society to hold its next annual convention in those cities.

A brief discussion ensued in which the President declared himself opposed to the holding of the meetings in the larger cities, and Mr. Wiedmer recommended that less time be devoted at the convention to the reading of papers and more to discussions favorable to the advancement of the Society.

On motion B. von Herff, seconded by Mr. Wiedmer, it was unanimously resolved that the next annual meeting of the Society be held at St. Augustine, Fla., some time between Nov. 1 and Dec. 31, 1916, at a date to be fixed later by the Executive Committee.

The Convention was thereupon declared by the President to be closed.

Peat Exhibition.

In connection with the meetings there was an interesting and instructive exhibition of peat and peat products held in the convention hall. The exhibit comprised material contributed by several of the members.

Among the most striking exhibits was a section of peat bog from surface to subsoil from the Saxonia Farm at Kalamazoo, shown by Mr. Kleinstueck, who had also on view a unique display of arrow heads, skulls, implements, etc., collected from the margins of the peat marshes, and a varied collection of peat samples, and peat products.

Mr. E. V. Moore showed a series of photographs illustrating the successful peat-fuel plant at Alfred, Ont.

One of the most notable features of the exhibition was the collection of grasses and grains grown on peat lands at the University Experiment Station Farm, Grand Rapids, Minn., illustrating by comparison with check plots the results obtained by various treatments, and arranged to illustrate the paper read by Prof. F. J. Alway, and the views shown by Mr. Bergh. This

exhibit also included samples of peat-moss litter, and other products of peat.

Mrs. Fred Osborne, of Ann Arbor, Mich., exhibited some fine specimens of Pe Tsai, the new "celery cabbage" from China, and other new vegetable products raised on peat lands near Ann Arbor.

Numerous samples of peat fuel, peat mosses, peat fiber, raw peat, and various products of peat were also shown.

Drawings and photographs of a new hydraulic press, traction diggers, and other machinery and various literature relating to peat lands and peat completed the display at the exhibition, which was generally pronounced a very successful feature of the convention.

Reports of the Local Press.

Considerable attention was devoted to the meetings by the press of the city of Detroit, reporters being present daily, and publicity thus given to the work of the Society must necessarily have a good effect.

Members In Attendance.

Carl Kleinstueck, Kalamazoo, Mich.
Prof. Charles A. Davis, Washington, D. C.
John Wiedmer, St. Louis.
Robert Ranson, Pablo Beach, Fla.
C. S. Robinson, East Lansing, Mich
L. A. Krupp, Findlay, Ohio
Prof. F. J. Alway, University Farm, St. Paul, Minn.
Mr. Fred Osborne, Ann Arbor, Mich.
Mrs. Fred Osborne, Ann Arbor, Mich.
B. F. Haanel, Ottawa, Canada.
Arthur J. Forward, Ottawa, Canada.
Ernest V. Moore, Peterboro, Canada.
Otto I. Bergh, Grand Rapids, Minn.
Prof. A. J. Patten, East Lansing, Mich
Paul H. Todd, Kalamazoo, Mich.
L. B. Arnold, Duluth, Wis.
Dr. H. E. Wiedemann, St. Louis.
Dr. J. McWilliam, London, Ont
F. J. Bulask, Toledo, Ohio.
A. B. Smythe, Cleveland, Ohio.
J. A. Elliott, Ridgetown, Ont.
A. Sheldrick, Chatham, Ont.
W. L. Bell, Bradford, Pa.
Mr. Guernsey, Hillsdale, Mich.
Prof. W. H. Allen, Detroit
Floyd W. Robison, Detroit.
W. A. McGoon, Detroit.
W. L. Dillon, Detroit.
J. N. Rankin, Bad Axe, Mich
Eli A. Stark, Toledo, O.
Henry J. Jarvis, Toledo, O
F. C. Rockwell

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EDITORIAL

The Journal. For some time your Executive Committee has considered means by which the punctual appearance of our Journal could be assured, and have conferred with Prof. Chas. A. Davis, our editor-in-chief, on this subject. Previous to the last annual meeting, an Editorial Committee was appointed, whose duty it is to lessen the burdens of Prof. Davis and to see that the Journal is punctually published. Prof. Davis outlined the plan at the annual meeting, and it met the full approval of the convention. Prof. Davis, as will be noted, still assumes many of his earlier responsibilities by accepting the chairmanship of this important committee, but he has so divided the work that many of the numerous details fall on other shoulders. Nothing, however, will appear in the Journal without his approval, and all our readers must realize the importance of his generous sacrifice in accepting his new position.

The Committee can make the Journal what it should be only through the active cooperation of the members of the American Peat Society. The members are earnestly asked to help the committee by writing us occasionally of what is going on in their vicinity in the development of peat deposits and peat industries, including their own experiences in the use of peat.

The American Peat Society has a mission to perform and those who have been members of long standing must realize today that our Society has already accomplished much, yet we

must not forget that vastly more has to be done. All who contribute to our knowledge on peat are increasing the resources of this continent and helping mankind in general.

Members who have the welfare of the Society at heart are requested to write the Editorial Committee about peat matters, either giving information or requesting it, and members are further asked to endeavor to induce others interested in our work to join us; in carrying out our requests kindly address Herbert Philipp, Perth Amboy, N. J.

THE INDEX FOR VOL. 8 WILL BE INCLUDED WITH OUR JANUARY, 1916 ISSUE NOW IN THE PRESS.

Abstracts, Patents, Etc.

Dr. Herbert Philipp, Editor

The Agricultural Uses of Radium.

T. Thorne Baker, in a paper read before the Royal Society of Arts, indicated some of the possible uses of radium, including its use in agriculture.

The use of radium in agriculture will be of extreme interest and importance to our readers, as peat forms an ideal soil in which to utilize radium compounds. However, to forestall any harmful effects from this powerful mineral the agriculturalist will do well to profit by the results already obtained. In this respect it is worth while to mention that several of our agricultural stations have been doing work with radium. Bulletin 177 of the Illinois Agricultural Experiment Station presents the results of which indicate that the experiments were entirely inconclusive as to the good or bad effects of radium on the crop. The reasons are perhaps explained by the paper of Baker, an abstract from which follows:

Radium has already passed through three stages in the way in which it has been regarded by the public. In its early days it was looked upon as something mysterious, which was to revolutionize modern science, prove an endless source of power and energy, and act as a panacea for all human ailments; it was exploited by many quasi-scientific people, and soon became regarded with something akin to suspicion. Then followed a period of forgetfulness as far as the public was concerned, while a great deal of careful, and seemingly rather unproductive, research work took place, till it reached the third stage, when its application to medical science became seriously recognized. There seems little doubt that radium is destined to play an important part in industrial work as well as in medical science.

It is not too much to say that in the hitherto worthless residues of the radium factories we have one of the most valuable agricultural assets of the country, which, if utilized with discrimination, will give a great impetus to intensive farming. The early results obtained in plant and vegetable growing with radio-active soil have been up to the present uncertain, and therefore disappointing. Recent experiments carried out in warm laboratory germinators have elucidated many points previously doubtful.

Radium is always associated with uranium in the proportion of about 3.4 parts of radium in 10,000,000 of uranium. In order to show the effect of uranium on vegetable life, I made some tests recently that gave very interesting results. Mustard seeds

were sown in soil in test saucers and placed in a germination box. Lot A was watered three times daily with tap water; Lot B with a 1 per cent solution of pure uranium nitrate, that is, uranium from which the radium had been extracted. The results were as follows: Lot A, 82 per cent of the seeds germinated; Lot B, 0 per cent of the seeds germinated. In other words the uranium had proved fatal. The experiment was then repeated, only this time Lot B was watered with a 1 per cent solution of active uranium nitrate, that is, uranium nitrate containing the equilibrium amount of radium. The results were as follows: Lot A, 81 per cent of the seeds germinated; Lot B, 56 per cent of the seeds germinated. You will thus see that, despite the ordinarily fatal qualities of the uranium, the radium was able to give sufficient vitality to the seeds to enable 56 per cent of them to germinate.

The importance of these experiments is that they show how necessary it is, if radioactive residues are to be used for agricultural work, that every impurity be known and, if possible, eliminated. A notable instance last year was that of a well-known seed firm, which carried out numerous tests with radium residues, and got great variations in the results, rendering the whole of the work somewhat doubtful. I found, on investigation, that the residues came from different sources, some containing copper and uranium, and one of the residues I happened to know contained no radium at all.

The process of producing radium salts that yields products most desirable for agriculture, is what is known as the concentration process. The residues, after full extraction of the radium on a commercial scale, are subjected to a method of concentration by which about 90 per cent of the inert material is discarded; the whole of the radium content is then found in the "concentrates," so that in any case any deleterious matter is reduced to one-tenth of the normal. But it so happens that in this process the heavier matter is discarded, so that a good deal of metallic residue is done away with, and there is very little in the final product but radium contained in silica. These concentrates are, however, not always available, but it may be taken for granted that the vanadium, uranium, or copper is usually extracted before the "residue" stage; on the other hand, weak radioactive earth supplied from the neighborhood of radium mines will very probably contain uranium or copper, or both, and will then be unsuitable for obtaining the best results. By fusion with crude caustic soda, or by vigorous boiling with alkaline carbonate, the radium and barium are obtained as insoluble carbonates; these are usually dissolved next in hydrochloric acid, and the radium barium chloride either precipitated as sulphate, or precipitated directly by the addition of sufficient concentrated hydrochloric acid.

It may be emphasized here that, in agricultural work, soluble radium salts in very small quantities completely kill

soil organisms, and that the use of too liberal a quantity of insoluble radioactive matter is almost fatal to plant life. I have found that 1 c.c. of 1:25,000 solution of pure radium bromide in 10 c.c. of culture medium entirely prevents the growth of ordinary soil bacteria.

Radium gives off three types of rays, the alpha, beta, and gamma rays. The beta rays are about 100 times as penetrating as the alpha rays, whereas gamma rays are 10 to 100 times as penetrating as the beta rays. In order to determine the effect of radium compounds on germination, tests were made in earthenware saucers with mustard seed, the saucers being placed in the electric germinator. This germinator consists of a stout metal or wood box, electrically heated, with glass shelves at different heights, and adequate temperature control. The seeds were subjected to a temperature of about 28 degrees C, for 16 hours a day, and about 15 degrees C during the remaining eight hours.

In test A the seeds were sown in ordinary mold, as a control; in test B also ordinary mold was used, but the seeds were watered with radium-emanation water, which gives only beta rays; in test C the seeds and soil were placed over radium-barium chloride, with a sheet of cardboard 1 millimeter thick separating it, so that the beta and gamma rays were effective; in test D a sheet of lead 3 millimeters thick was interposed, so that gamma rays alone could influence the germination.

The effect of the radium-emanation water was marked, as 100 per cent of the seeds germinated, and the seedlings grew in each case at a uniform rate. In the control test about 90 per cent of the seeds germinated, but, as is common in these cases, the growth was erratic, about half the seedlings developing normally, the other half being dwarfed by lack of vitality. The beta rays of radium, especially when administered in the form of emanation water, have always, in my experience, shown a pronounced tendency to increase the vitality of plants.

Although not much difference is to be detected between the action of the alpha and the beta rays, the gamma rays seem to produce a more deleterious effect than the beta rays; this is not remarkable when we consider the effect the X-rays, which are largely identical with gamma rays of radium in their destructive power on micro-organisms. The beta rays are also present in far greater abundance.

The importance of these experiments is that they show that: (a) The beta rays are largely responsible for increased vitality and quicker germination, hence the great advantage of sowing the seeds in earth prepared with the radioactive matter; (b) the emanation is of value to plant growth, and hence, if radioactive matter is laid over the soil, the rain, or the watering, will produce to some extent emanation water which will sink through the earth, reach the roots, and hence be of benefit in accelerating growth.

A convenient form of apparatus for preparing emanation water on a cheap scale is made as follows: Radioactive material, insoluble in water, and containing 200 or 300 milligrams to the ton, is packed between fine muslin stretched over wooden frames, and these frames are placed vertically, an inch or two apart, in an enameled iron tank provided with a tap at the bottom and a well-fitted cover at the top. The tank is filled with water, left for a week or a fortnight, and the water then drawn off as required. By having two such tanks, used on alternate weeks, a continuous supply can be easily obtained.

A more simple apparatus is well suited for laboratory experiments, and is easily put together. A filter flask, of 2-liters capacity, is provided with a delivery tube and tap, the tube projecting below the surface of the water inside the flask, and a scent-spray bulb is fitted to the tube at the side, so that when the bulb is pressed the water is driven by air pressure through the delivery tube. At the bottom of the flask is distributed on the largest possible surface 5 grams of finely divided precipitated radium-barium sulphate of about 1 in a million concentration, and the flask is a quarter filled with 500 c.c. of water. For germination tests, milk and cheese experiments, and so on, I have found this a most useful little apparatus, and the emanation experiments above described have all been done with water prepared in it, the water having been left in contact with the radium-barium sulphate for one month before use.

I should like to refer to a radioactive fertilizer with which I have been experimenting for some three years, known for industrial purposes as "Nirama." This consists of radioactive matter from which practically the whole of the deleterious inorganic matter has been extracted; after the radium content has been definitely ascertained, it is diluted to a uniform standard with finely sifted and sterilized soil. In order to cope with the demand of the plants, owing to their rapid growth, for more chemical nutrition, nitrogen and phosphoric acid are added in suitable forms, and the effect is in many cases to get anything up to 100 per cent quicker growth, with noticeable moistness and fullness, as against coarseness and bitterness in taste which often result from hasty or too abundant growth.

Provided uniformity as regards radioactivity be obtained, and sufficient chemical manure be employed to let the plants take the full advantage of the radium stimulus, there is little doubt that this type of fertilizer will play a highly important part in future agricultural chemistry.

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American Peat Society

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If you are interested in any degree whatever in Agriculture, Power and Fuel, Chemistry or any other uses of Peat, you should let us help you and you help us by becoming a member of the American Peat Society.

OBJECTS AND FOUNDATION.

Founded at the Jamestown Exposition on October 23rd, 1907. Its object is to further the interest in the uses and application of peat for industrial and economic purposes.

PUBLICATIONS.

The Society holds one general meeting per year, and publishes a Journal quarterly, which is sent to all members in good standing. The journal includes the proceedings of the meetings, original papers on practical experience, etc., also abstracts on all contemporary literture and patents, thus all the latest agricultural uses, fertilizer purposes, drainage, fuel, uses, technical uses, etc.

SOME ECONOMICAL POINTS OF INTEREST.

Prof. Chas. A. Davis, U. S. Bureau of Mines, estimates that there are about 12,000 sq. miles of workable peat beds in the United States, outside of the large number of beds very advantageously adapted for agricultural purposes, etc. He gives as a conservative average estimate a yield of 200 tons dried peat per acre foot.

Canada has at least 37,000 sq. miles of known peat deposits.

About ten million tons of peat are used in Europe each year.

GENERAL INFORMATION AND INQUIRIES.

All members have the privilege of making inquiries regarding general information about peat and its uses, by addressing the Secretary of the Society.

It must be understood that only general information and of a general character can be given. Members can obtain the names of experts in any special line, from the Secretary of the Society.